R 27 Ballistic Missile: Submarine Ballistic Missile R-27 (4K10, RSM-25)

Content

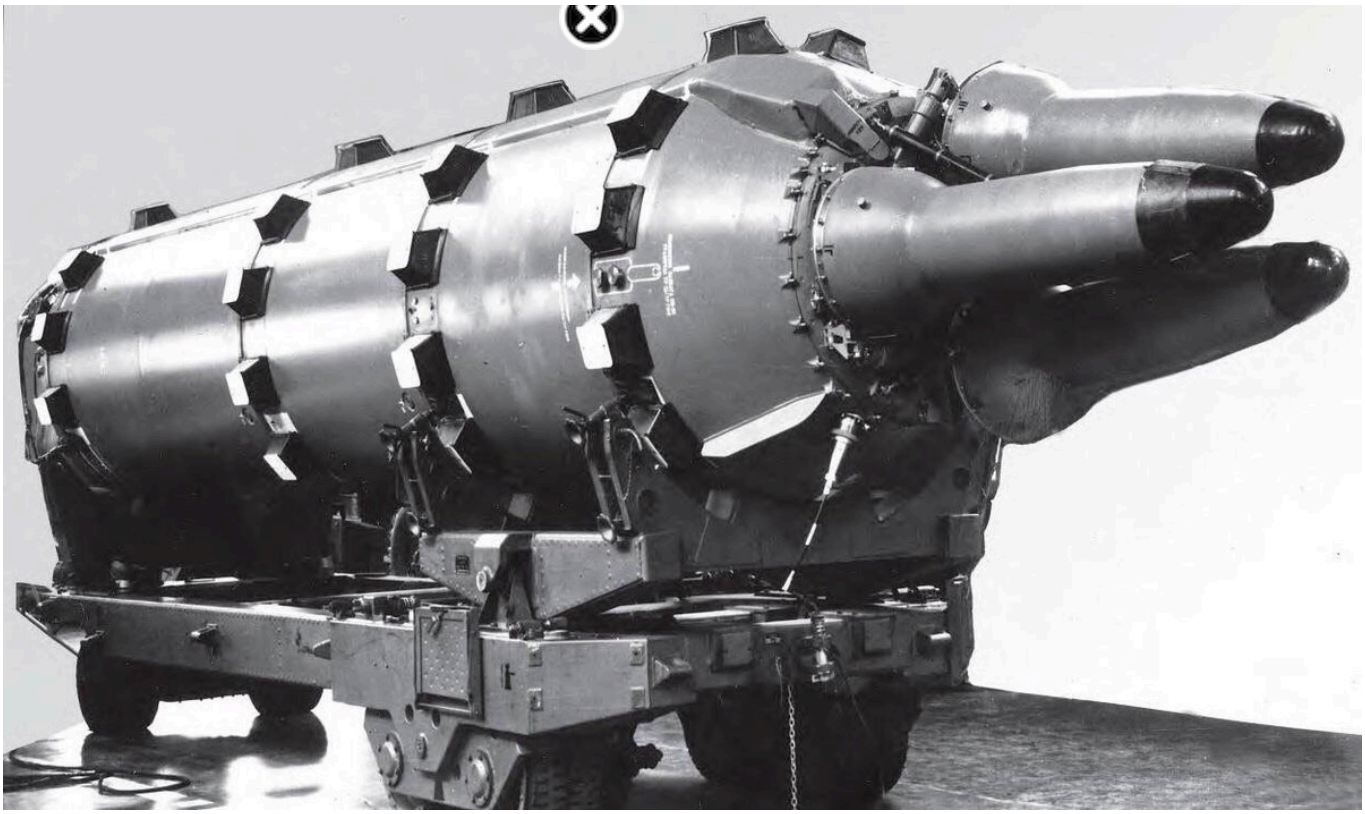
Submarine ballistic missile R-27 (4K10, RSM-25)

The results obtained during the development of domestic first-generation submarine-launched ballistic missiles (SLBMs) (R-11FM, R-13 and R-21) and their comparison with American achievements in this area (Polaris A1, Polaris A2) led to the formulation of the question of the need for a qualita leap in the development of naval strategic forces. The main directions of their development were also

clear: a manifold increase in the ammunition load of missiles on a submarine; reducing the size of missiles, warheads, launchers (missile launch systems) and missile silos; automation of missile maintenance processes during storage, pre-launch preparation and salvo firing; every possible improvement in the tactical and technical characteristics and operational qualities of missiles and missile systems, etc. The purpose of developing new complexes was to ensure the development of the second effective component of the country's strategic missile forces - naval strategic nuclear forces. To achieve this goal, significant progress was needed in domestic naval rocketry.

The R-21 missile of the D-4 complex with a firing range of 1,400 km, adopted by the Russian Navy in 1963, was significantly inferior in its main characteristics to the American Polaris A1 (1960, 2,200 km) and Polaris A2 (1962, 2,800 km) missiles. In addition, as noted above, the number of SLBMs on a typical American missile submarine significantly exceeded the number of SLBMs on a typical Soviet missile submarine - 16 versus 3. To eliminate the backlog, the development of both a new missile and a new nuclear submarine was required.

On April 24, 1962, Resolution No. 386-179 of the Council of Ministers of the USSR was issued on the development of a new R-27 missile of the D-5 complex for arming new nuclear missile submarines of Project 667A. SKB-385 was appointed as the lead developer for the missile and complex, the chief designer was V.P. Makeev. The development of the missile control system was entrusted to NII-592 (chief designer N.A. Semikhatov), and the placement of the complex on a Project 667A submarine was assigned to TsKB- 18 (chief designer Kovalev S.

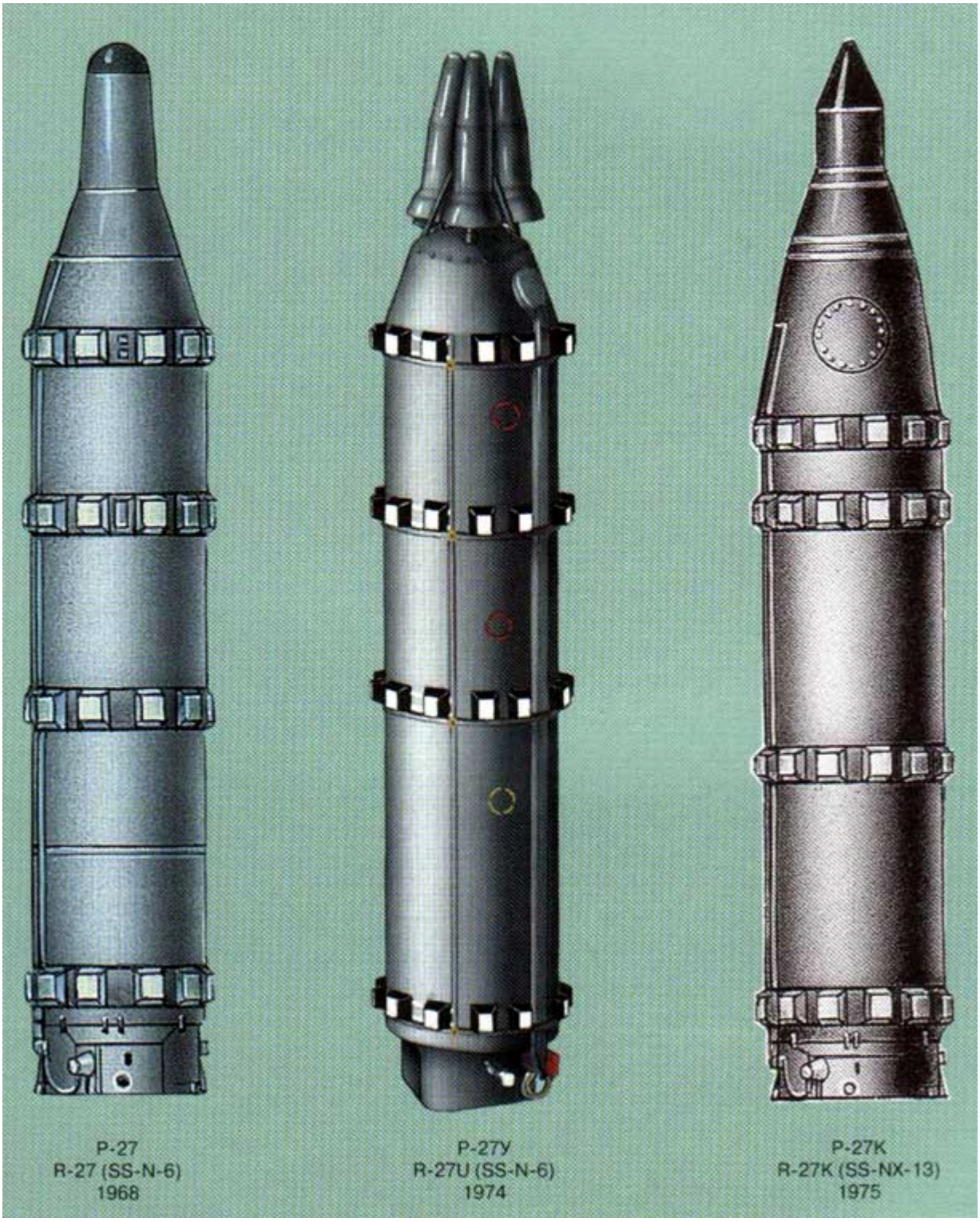


N.).

Testing of the D-5 complex was carried out in three stages. The first stage of throwing tests of full-scale prototypes of the R-27 was carried out from the PSD-5 floodable floating test bench in September 1965. Two launches were carried out. In January 1967, testing of missile models began in the Black Sea from the Project 613D5 submarine (an experimental Project 613D7 submarine converted at Plant No. 444 in Sevastopol) in an underwater position. The delay in work was due to the fact that the customer received the boat only on December 23, 1965. On January 18, 1967, the first launch of a prototype 4K10 rocket was carried out from a depth of 45 m at a boat speed of 3 knots, sea state of 3 and wind speed of 7-8. The last, sixth test was carried out on August 10, 1967. The second stage was carried out in parallel. Flight tests from a ground stand at the Kapustin Yar test site were carried out from June 1966 to April 1967. A total of 17 launches were carried out, of which 12 were considered successful. Full-scale joint flight tests of the R-27 began in the Northern Fleet on the lead boat of Project 667A, the K-137 Leninets, in August 1967.

A total of 6 launches were carried out. Starting with Project 667A, all domestic nuclear-powered missile submarines of new projects bore the name “strategic nuclear-powered missile submarine.” The D-5 complex with the R-27 missile was adopted for service on March 13, 1968 by Decree of the USSR Council of Ministers No. 162-164. Compared to previous SLBM systems for the Soviet Navy, the D-5 complex represented a giant leap forward. As part of the Red Banner Northern Fleet, the first fleet to receive new ships, Project 667A SSBNs entered the 19th and 31st divisions.

At the same time, in comparison with the SLBMs of the potential enemy, there was still a significant lag - the US Navy had already received more advanced SLBMs Polaris A3 (1964, 4600 km, the world's first ballistic missile with a dispersive type MIRV, 3 BB) and Poseidon C3 (1971, 4600 km, the world's first SLBM with MIRV, 10 BB). In 1968, Great Britain, the second most powerful NATO country, also acquired naval strategic nuclear forces: the Polaris A3T SLBM (a version of the Polaris A3 with increased resistance to nuclear weapons) entered service.In 1971, France also acquired its own M1 SLBMs (2,600 km), which sought to pursue a nuclear policy

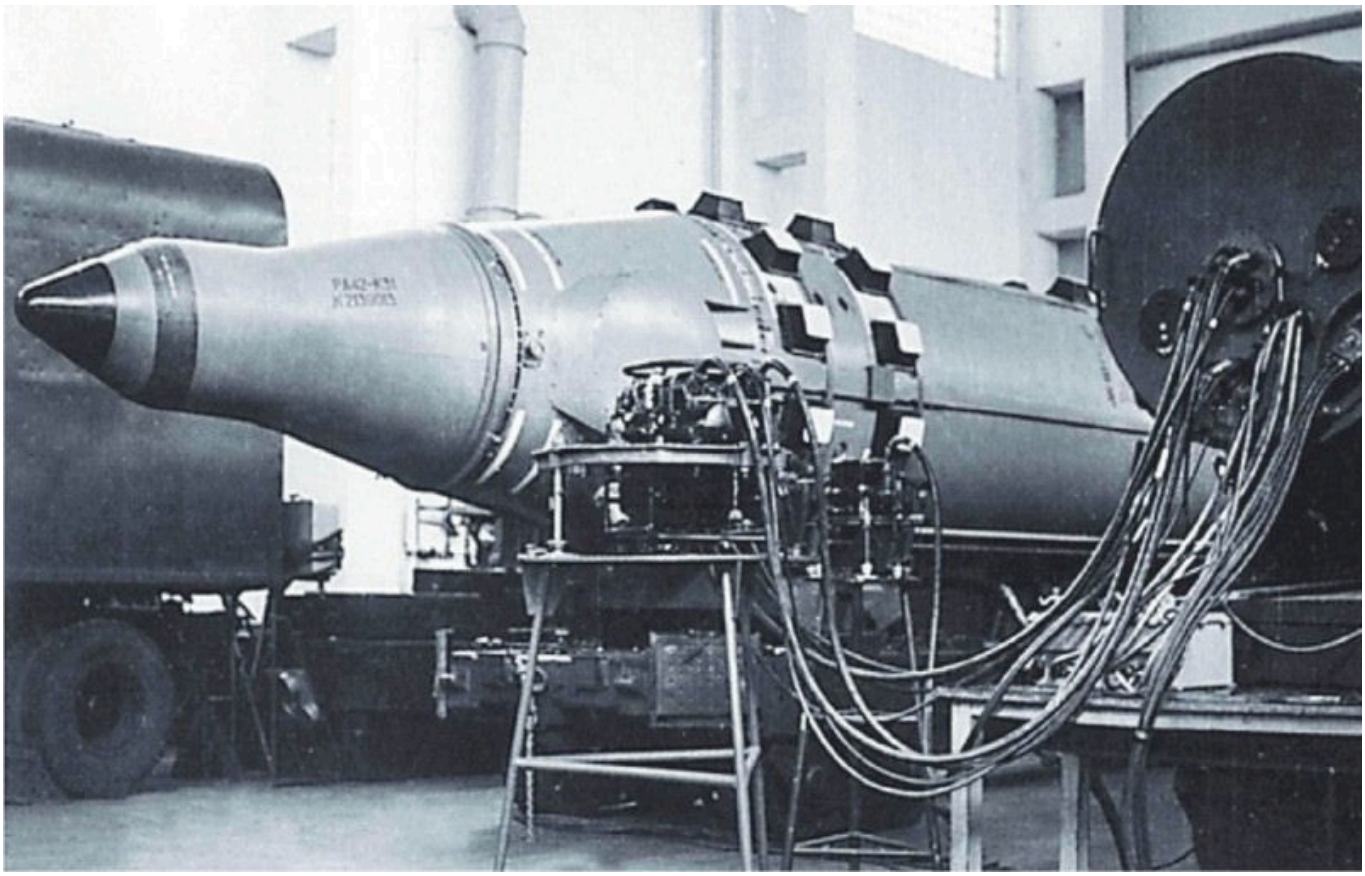


independent of the United States.

Under these conditions, on June 10, 1971, a Resolution of the USSR Council of Ministers was adopted on the modernization of the D-5 complex. The goal was to create two versions of the modernized rocket.

The first version provided for equipping the missile with a warhead with three warheads, while maintaining the maximum firing range of the previous version and improving accuracy characteristics. The second option was intended to increase the firing range while simultaneously increasing accuracy. According to the second option, a missile with a range of 3000 km and a lightweight monoblock thermonuclear warhead with a power of 1 Mt was created. The modernized version of the complex was designated D-5U, and the missiles were designated R-27U.

Ship tests of R-27U missiles took place from September 1972 to August 1973. 16 launches were carried out, all considered successful. The R-27U missile was adopted for service on January 4, 1974 by resolution of the Council of Ministers No. 8-5.The D-5U complex with R-27U missiles was equipped



with Project 667AU nuclear-powered missile submarines under construction (4 pieces), as well as Project 667A boats after modernization (8 pieces). In total, at two shipbuilding enterprises (shipyards in the cities of Severodvinsk and Komsomolsk-on-Amur) from 1967 to 1972, 34 SSBNs of projects 667A “Navaga” and 667AU “Navaga” were put into operation (according to some sources, SSBNs built in Severodvinsk, had the designation “Navaga”, and in Komsomolsk-on-Amur - “Burbot”). Missile carriers built according to the latest project, in addition to improved missiles, had reduced noise, modernized navigation complex and communication systems, etc. In addition, in 1981, SKB-385 completed the modernization of the D-5 complex, associated with the replacement of the monoblock warhead with a monoblock warhead from the D-5U complex, which made it possible to increase the firing range (D-5M complex). During the modernization of the D-5 complex and the R-27 missile, no specialized design improvements were made to the SSBN systems and missile complex systems placed on the SSBN (“under the missile”).

The algorithms of digital computer systems and databases related to the preparation of a flight mission and the operation of a new type of warhead were adjusted. Ground equipment is basically similar to that for the D-5 complex.

The modifications described above were not the only ones: the initial resolution of the Council of Ministers of April 24, 1962 on the creation of the D-5 complex also provided for the creation of a missile with a homing warhead capable of hitting moving ships. The anti-ship version of the missile was designated R-27K (GRAU index 4K18). Testing of the complex with the R-27K missile began in December 1970. The ground test cycle at the Kapustin Yar test site included 20 launches (of which 16 were considered successful). A diesel-electric submarine, Project 629 K-102, with 4 missile silos on board, was converted to carry missiles under the experimental Project 605. The first launch from a submarine was carried out in December 1972. And in November 1973, the tests ended with a two-missile salvo.

A total of 11

launches were carried out, of which 10 were considered successful. During the last launch, the target ship was hit by a direct hit from a guided unit. In 1974, the rocket was put into trial operation.

In the 1990s, work was carried out to create launch vehicles based on submarine-launched ballistic missiles. The Zyb launch vehicle was created on the basis of the R-27. The rockets were used in research experiments requiring microgravity. The period of weightlessness lasted from 17 to 24 minutes. “Zyb” could launch a payload with a volume of up to 1.5 m3 into suborbital orbit. The pa mass could reach 650 kg at a maximum orbital altitude of 1800 km or 1000 kg at an orbital altitude of

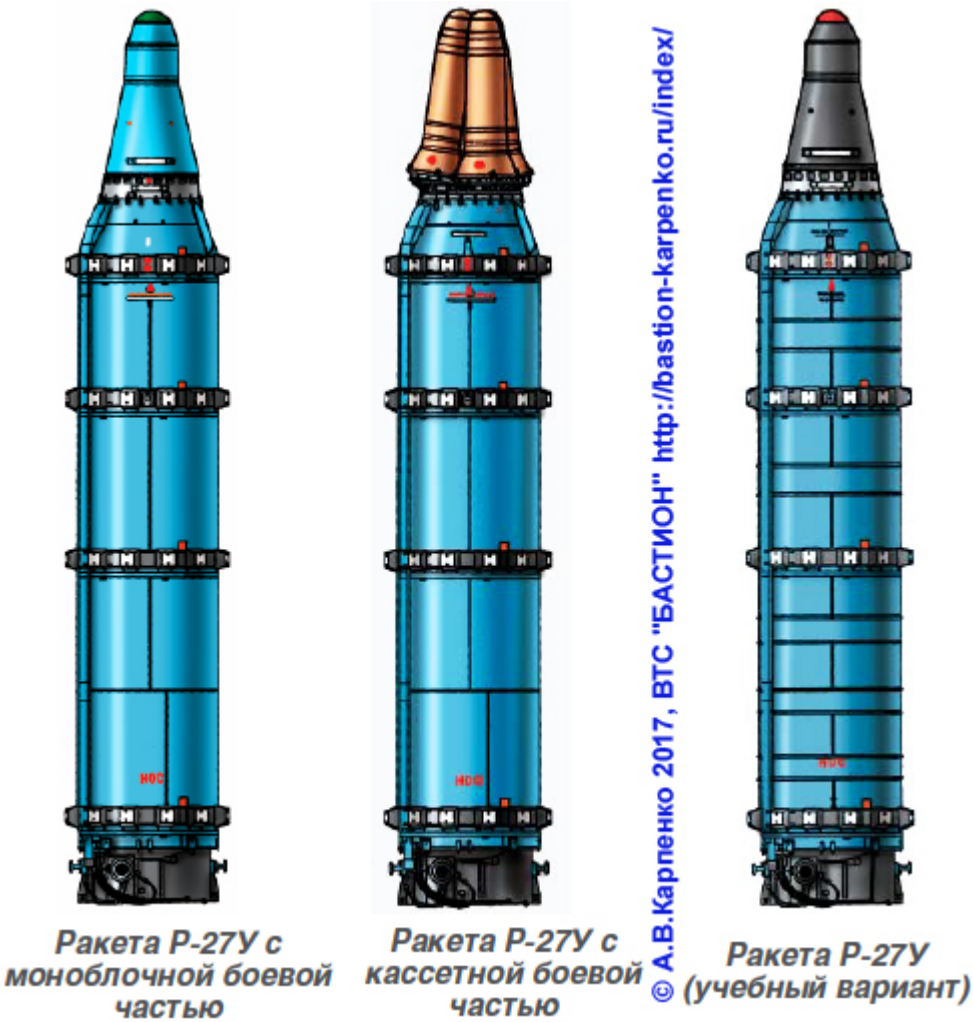
1000 km. Three launches were carried out. December 1, 1991, the Sprint module, developed by SKB-385 together with NPO Composite, was launched. The module was intended for testing technologies for producing superconducting materials and carried 15 exothermic furnaces on board.

On December 9, 1992 and December 1, 1993, the “Ether” module was launched with the “Medusa” biotechnological equipment weighing 80 kg. The module, developed jointly with the Center for Space Biotechnology, was intended for research into the technology of purifying biological and medical preparations using electrophoresis under zero-gravity conditions.

The D-5 complex was operated from 1968 to 1998. In total, about 1,800 missiles were produced, 492 missile launches were carried out, of which 429 were considered successful. The maximum number of launches was in 1971 - 58. This is a kind of record for Soviet and Russian ballistic missiles from submarines. The complex also holds the record for the average annual number of launches - 23.4. During operation of the D-5U complex, 161 launches were carried out, of which 150 were successful. The last launches of R-27 and R-27U missiles according to combat training plans were carried out in 1988. After this, launches were carried out only for research purposes. During operation, 8 missiles were fired in one salvo twice (once each in the Northern and Pacific fleets).

All launches were considered successful. Over the entire period of operation, more than 10 thousand missiles were loaded and unloaded; boats armed with RSM-25 carried out 590 combat patrols in various areas of the World Ocean.

During operation, several accidents occurred with the destruction of missiles. 6 people were killed and one SSBN was lost. During loading with a violation of the loading and unloading process, the rocket fell from a height of 10 m onto the pier. The oxidizer tank was destroyed. Two people from the loading party died from exposure to oxidizer vapors on unprotected respiratory organs. A rocket was destroyed three times in the silo of a boat on combat duty. In 1973, on the K-219 boat located at a depth of 100 m, due to a false operation of the irrigation system when the mine drainage valve and the manual valve on the jumper between the main drainage line of the boat and the mine drainage pipeline were open, a communication between the missile silo and sea water occurred. The pressure of 10 atmospheres destroyed the rocket tanks. While draining the mine, rocket fuel ignited, but the timely operation of the automatic irrigation system prevented further development of the accident.



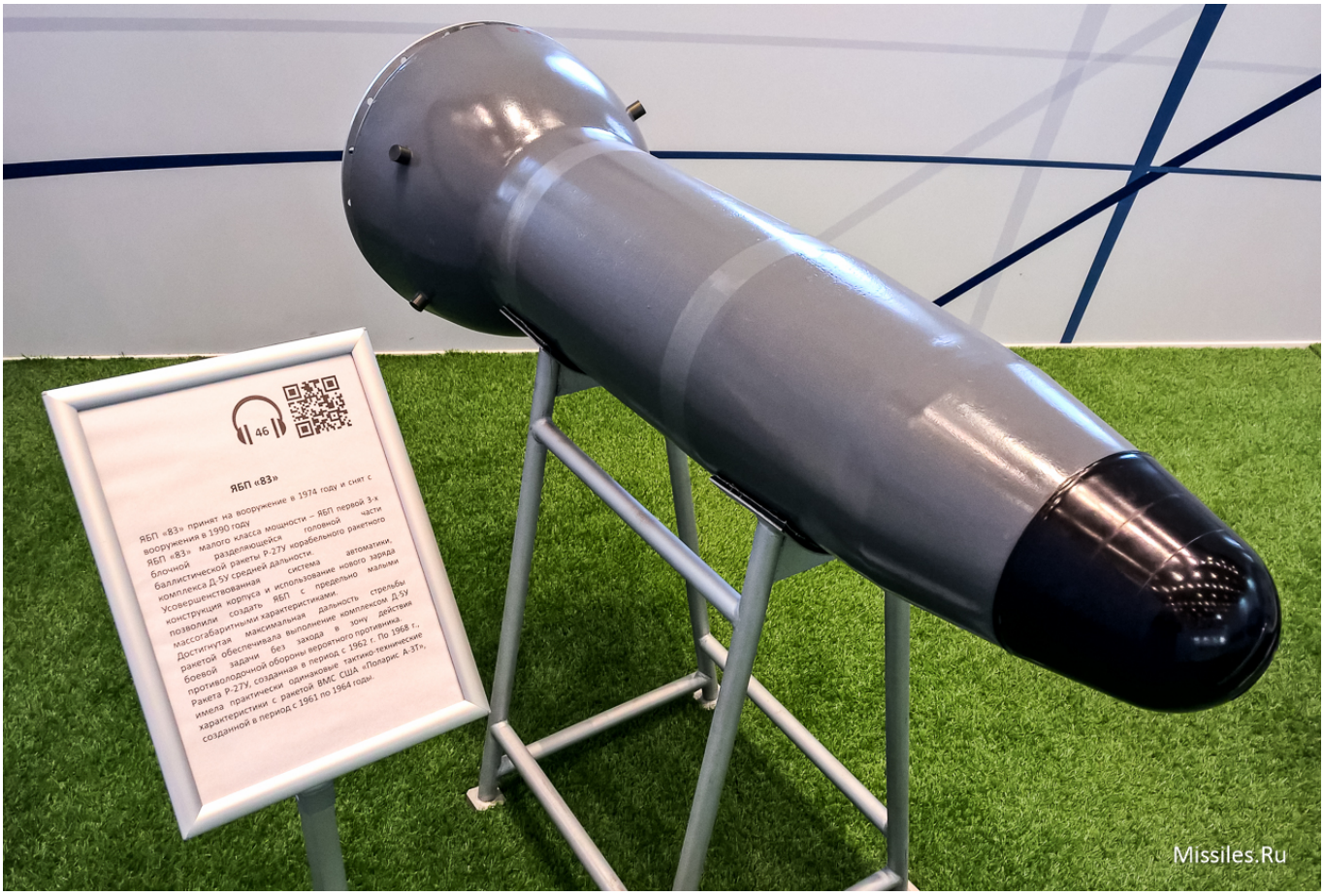
Ракета Р-27У с моноблочной боевой частью

Ракета Р-27У с кассетной боевой частью

Ракета Р-27У (учебный вариант)

The boat returned safely to base. During the Ocean-76 exercise, three missiles were pre-launched on the K-444 boat. Two missiles were launched, but the third missile was not fired. Due to a series of human errors, the pressure in the rocket tanks was released before the boat surfaced. The seawater pressure destroyed the rocket tanks, and during the ascent and draining of the mine, the oxidizer leaked into the mine. Thanks to the skillful actions of the personnel, the emergency situation did not develop. The third incident also occurred on the K-219 boat on October 3, 1986. For unknown reasons, during the dive after a communication session, water began to flow into the missile silo. The crew tried to turn off the automation and drain the water using non-standard means. As a result, the pressure first became equal to the outboard pressure, and the rocket tanks collapsed. Then, after draining the mine, fuel components ignited. The disconnected automatic irrigation system did not work, and an explosion occurred at a depth of 85 meters. The explosion tore off the cover of the missile silo (see.photo), a fire started in the 4th missile compartment. During the fire and smoke in the

4th and 5th missile compartments, 3 people were killed, including the commander of the warhead-2. The crew was unable to extinguish the fire with their own efforts; the missile carrier lost energy and speed. Later, during the procedure for decommissioning the power plant, another person died. An attempt to organize the towing of the SSBN to Cuba with the help of approaching Soviet ships was unsuccessful. The compartments began to fill with sea water, and the personnel, after more than 3 days of heroic struggle for survivability, were forced to gradually abandon the damaged missile carrier, which sank on October 6 at a depth of 5.65 km in an area 1000 km northeast of Bermuda. This disaster, taking into account the Chernobyl radiation disaster that occurred just over 5 months earlier and the radiation psychosis that appeared in the world, dealt a new serious blow to the international prestige of the USSR. The operating experience of RSM-25 missiles was analyzed and taken into account when developing new complexes.As a result, during the operation of SLBMs with liquid rocket engines of



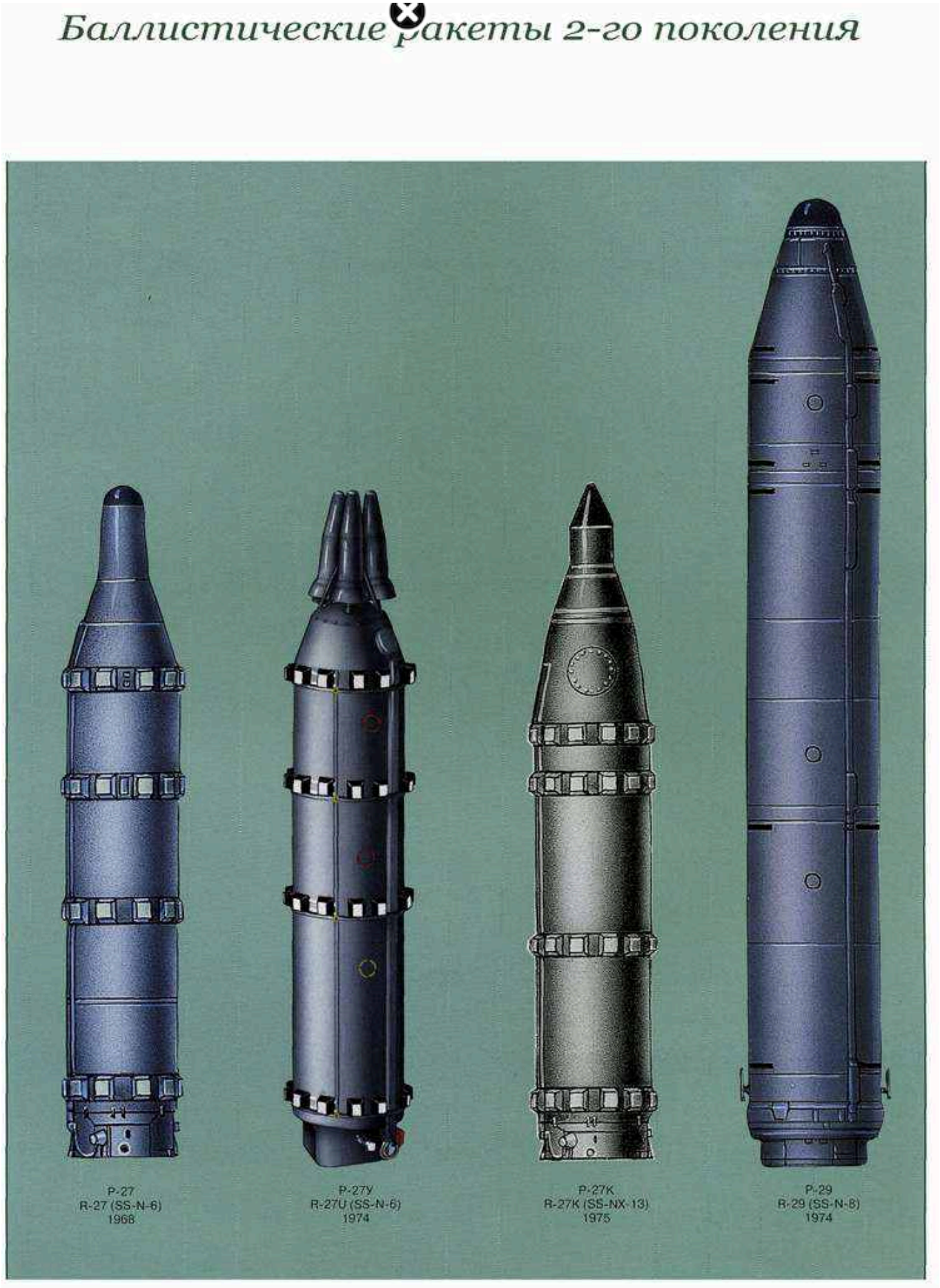
subsequent modifications, there was not a single case of loss of life.

The first Project 667A missile carriers began to be withdrawn from the fleet in accordance with Soviet-American agreements in the field of arms reduction already in 1978 in order to maintain the number of nuclear weapons carriers at a certain level. Some of the missile carriers were converted into special-purpose submarines (2 units, projects 09774 and 09780), some were transformed into submarines with strategic Granat SLCMs (3 units, project 667AT). One missile carrier was modernized under Project 667M for the purpose of testing the Meteorit strategic SLCM. Others were taken out for conservation with the cutting out of the missile compartment and subsequent disposal. The R-27U modification was withdrawn from service even before the collapse of the Soviet Union, in 1989. Other modifications of

the missile were removed from service in Russia as part of the implementation of the START-1 treaty. According to the September 1990 memorandum, 192 nuclear warheads were deployed on the territory of the USSR on the R-27 (192 SLBMs, 16 SSBNs at 3 bases [Yagelnaya at KSF, Rybachy and Pavlovskoye at KTOF]; another 142 SLBMs were stored undeployed at the same bases).In addition, 173 non-deployed RSM-25 SLBMs were located at 3 SLBM storage points (Okolnaya, Revda and Nenoksa) and the Pashino SLBM conversion and disposal facility. As of July 1997, Russia had 16 deployed warheads (1 SSBN) on the R-27. By 1998, all R-27 missiles were taken out of service.

The relatively short range of Soviet missiles necessitated combat patrols of Soviet SSBNs in the areas of operation of powerful anti-submarine defense forces of the US Navy and NATO (primarily off the East and West coasts of the United States), which significantly reduced the combat stability of Soviet missile carriers (especially in the 80s). However, despite a number of shortcomings, the USSR managed to create a fairly effective strategic missile system, thanks to which the Soviet strategic nuclear forces entered a qualitatively new stage of their development. The appearance in the Navy of a significant number of completely modern SSBNs with a significant number of SLBMs on each made it possible to significantly increase the likelihood of a guaranteed retaliatory strike, primarily taking into account the accuracy of the new missiles, i.e.n. “soft” targets - political, economic and industrial centers. A number of new technical solutions were tested for the first time on the R-27 rocket. The use of these developments on subsequent missile systems subsequently made it possible to completely eliminate the gap with the United States in this class of weapons, and in a number of areas (astroinertial control systems, intercontinental-class SLBMs, etc.) and to get ahead of the United States.

The R-27 missile had the “Western” designation SS-N-6 Serb mod.1, modifications of the R-27U - SS-N-6 Serb mod.3 and mod.2, R-27K - SS-NX-13. Project 667A (AU) missile carriers had the code designation Yankee.


Баллистические ракеты 2-го поколения
Р-27
R-27 (SS-N-6)
1968
Р-27У
R-27U (SS-N-6)
1974
Р-27К
R-27K (SS-NX-13)
1975
Р-29
R-29 (SS-N-8)
1974

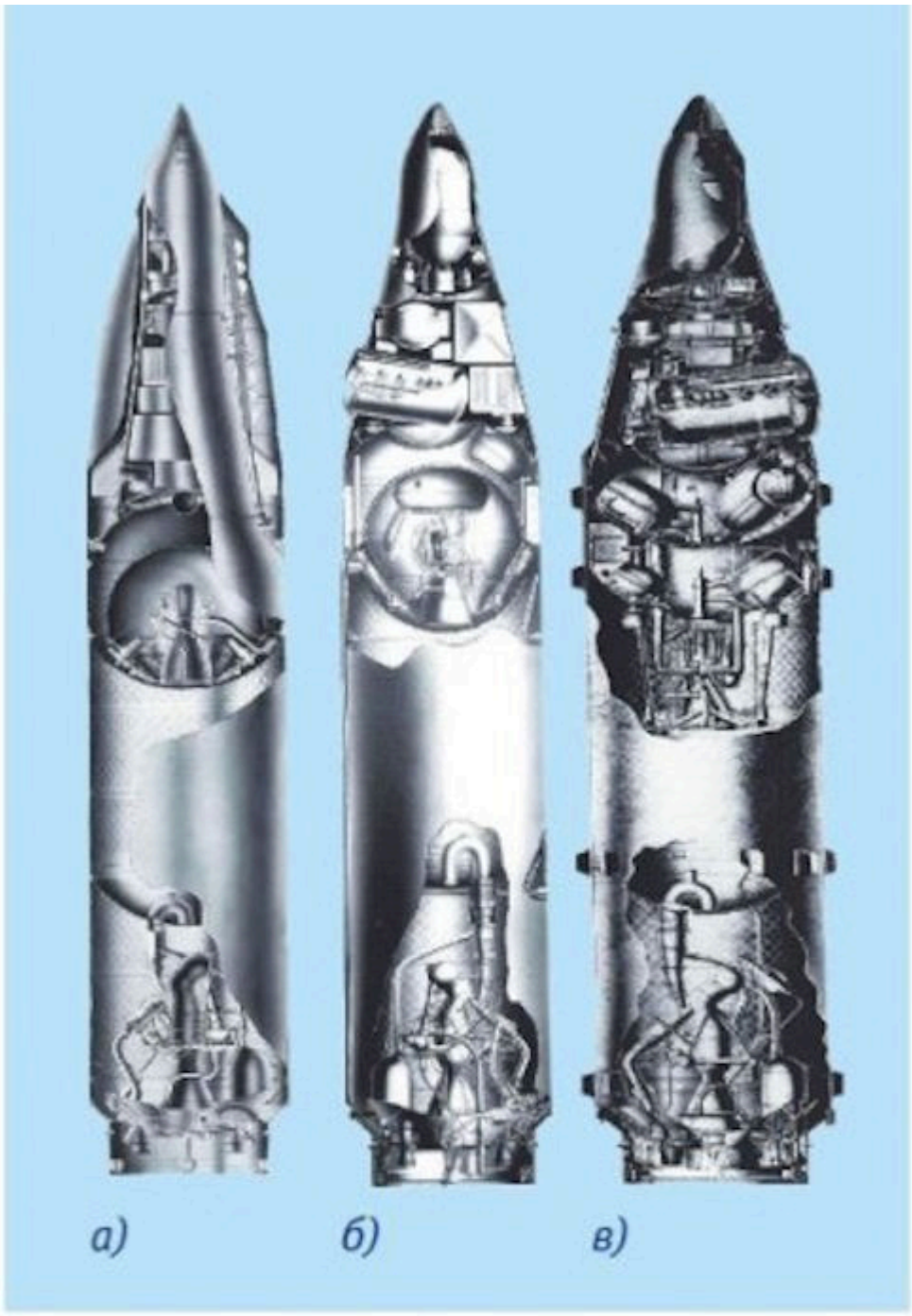
R-27 submarine-launched ballistic missile

03/13/2019

In 1963, the D-4 complex with the R-21 missile was adopted into service with the submarine forces of the USSR Navy. For the first time in domestic practice, it was possible to implement an underwater launch of a missile, which had a positive effect on the survivability of carrier submarines and the effectiveness of missile use.However, there was still a noticeable gap behind the potential enemy. By this time, the US Navy already had UGM-27B Polaris A-2 missiles with a flight range of up to 2800 km and operated submarines capable of carrying 16 such products. A new qualitative leap was required, capable of reducing or eliminating the existing backlog. The response to such circumstances was the appearance of the D-5 missile system, armed with the R-27 missile.

The decision to create a new weapons system for submarines was made in April 1962 and secured by a corresponding resolution of the Council of Ministers. The defense industry was required to develop a promising nuclear submarine and arm it with a new missile system. The missile of this complex was supposed to be able to deliver a special warhead at a range of up to 2500 km. In addition, in the future it was planned to create a modernized version of the rocket with improved characteristics. The pr of

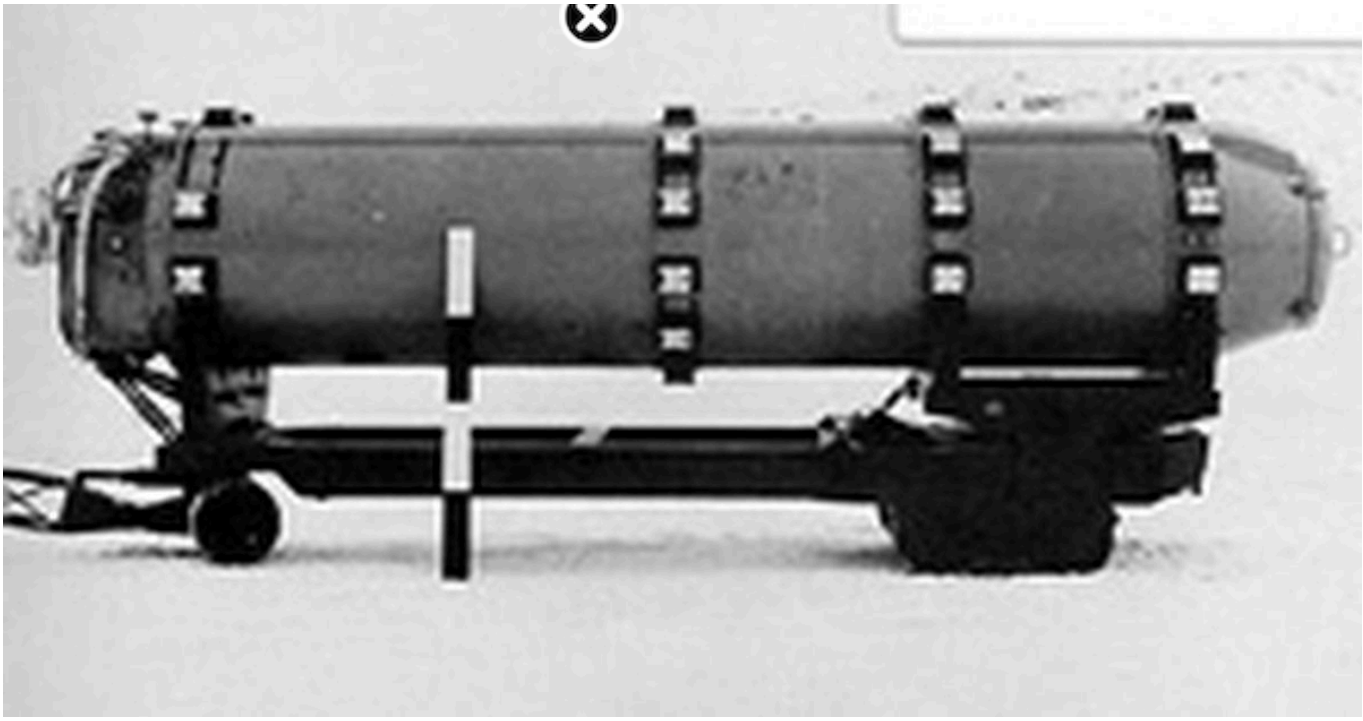
the promising complex was designated D-5, the missiles for it were R-27 (Navy missile and artillery weapons control index - 4K10).The nuclear submarine carrier received the designation “667A”.



Варианты ракет Р-27К :
а) проектный – с комбинированной (баллистической и аэродинамической) коррекцией;
б) проектный – с баллистическими коррекциями;
в) реализованный – с баллистическими коррекциями.

The designers were given several extremely difficult tasks. It was necessary to create a small-sized ballistic missile with high flight range and improved performance characteristics. The first studies showed that meeting new requirements requires abandoning a number of proven and time-tested ideas, using original solutions instead. New ideas were required in the field of unit layout and other non-standard solutions, new products, etc.

During the first stages of the R-27 project, several original proposals were formed, which were later used to create a new rocket. Moreover, a number of these developments were subsequently used in new missile technology projects and in fact became the basis for subsequent weapons of the submarine fleet. It can be argued that within the framework of the D-5 / R-27 project, the final formation of the modern appearance of domestic b c submarine missiles began.



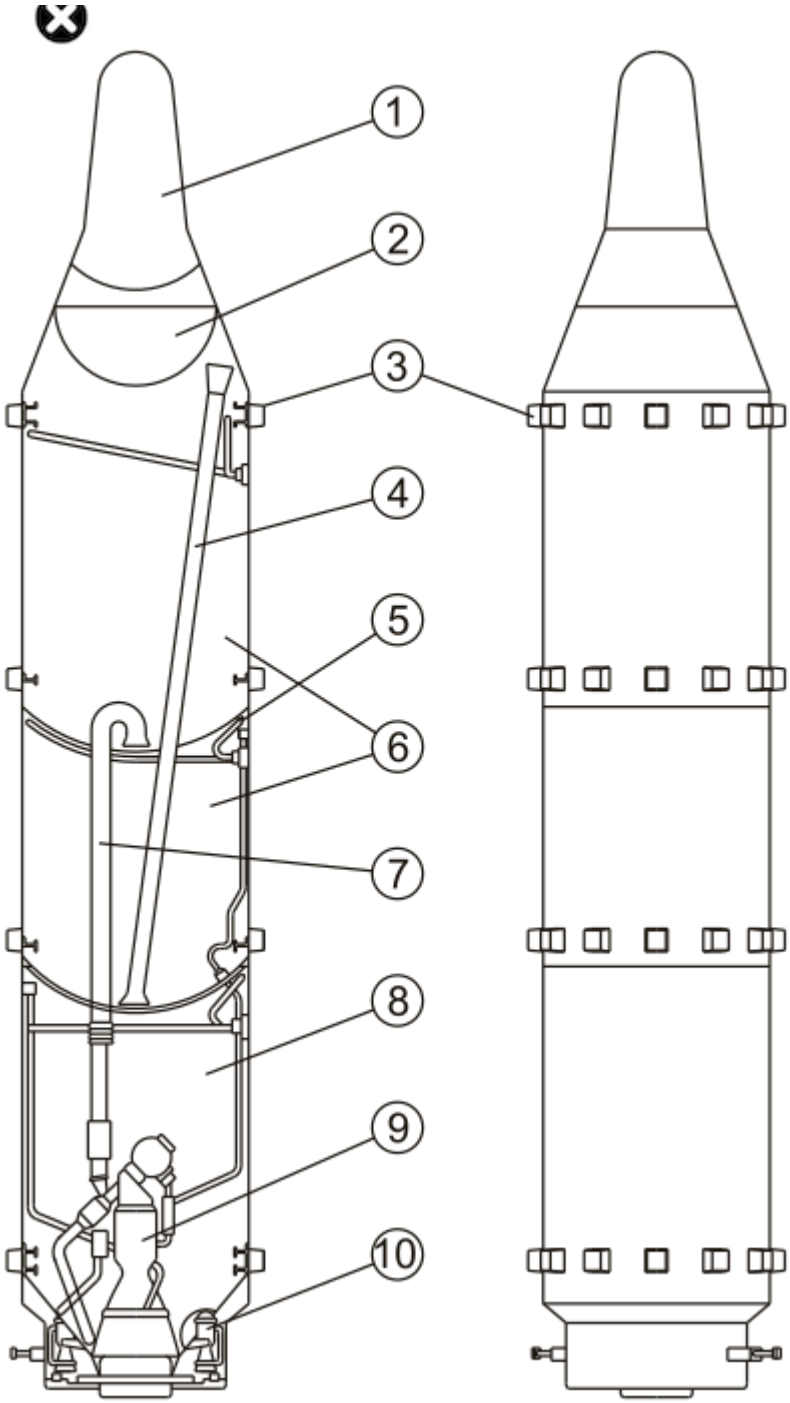
The main “stimulus” for the emergence of new ideas and solutions was the requirement to reduce the size of the rocket. To reduce the size of the product while simultaneously increasing the flight range in comparison with existing samples, it was necessary to use a more dense arrangement of internal volumes. First of all, it was decided to abandon the traditional layout of the case with a pronounced division into compartments. Instead, the internal volume had to be divided by several partitions for various purposes. It was also decided to abandon aerodynamic stabilization in flight, which made it possible to reduce the transverse dimensions of the product.

The body of the single-stage R-27 rocket was supposed to have a complex shape formed by several surfaces. The fairing was made of two conical surfaces and a hemispherical head part. The rest of the rocket body was made in the form of a cylinder with a slightly narrowed tail section. Stabilizers or other large protruding parts were not provided.At the same time, four transverse belts of rubber-metal shock absorbers were placed on the outer surface of the body, holding the missile inside the launcher in the required position.

The supporting body was made of so-called. wafer shells made of aluminum-magnesium alloy AMg-6 using chemical milling technology and connected by welding. This design ensured the required strength of the body with minimal weight of the parts. To protect against water after launch and heating during flight, the body received a special coating based on asbestos textolite.

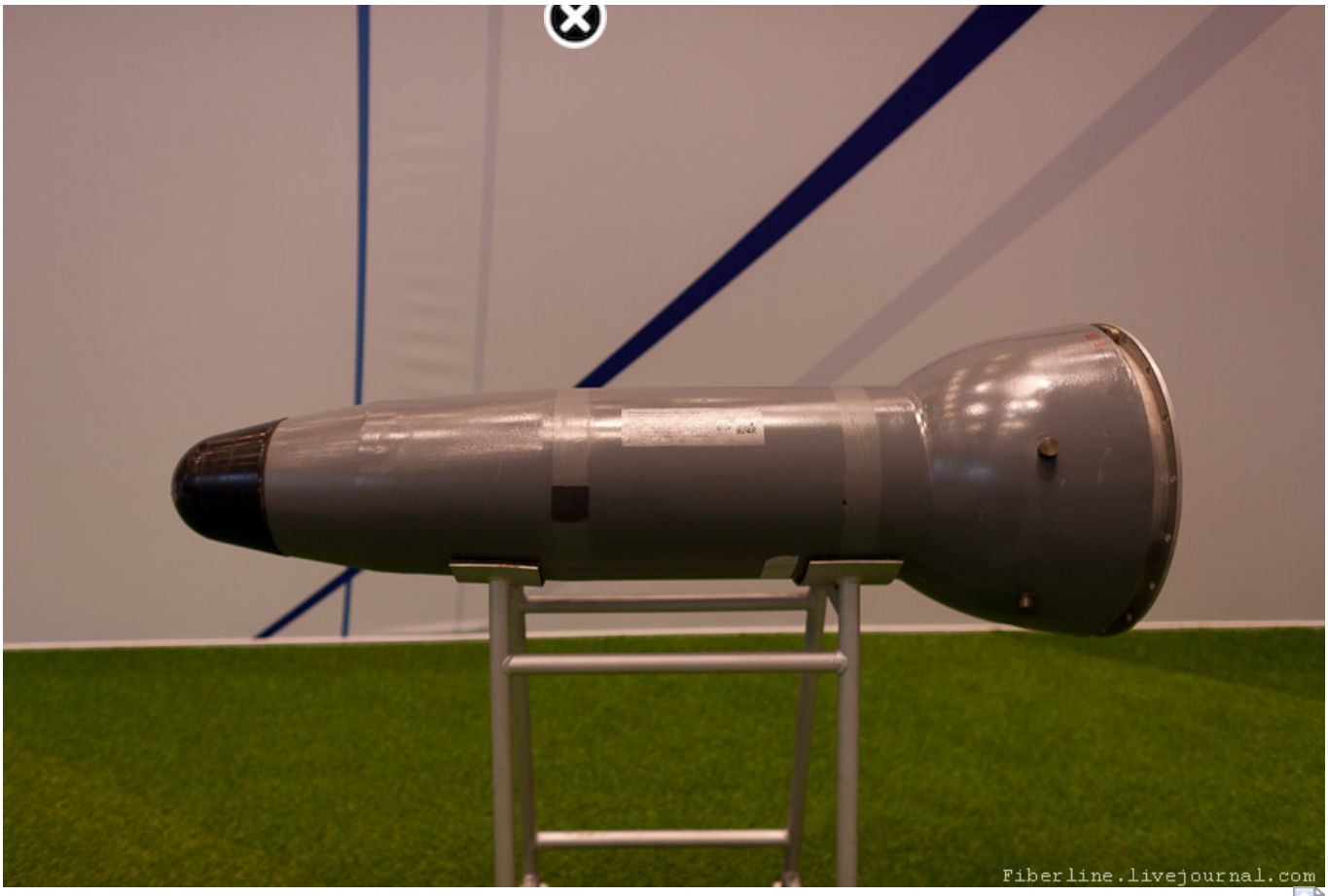
The head part of the rocket (the upper conical part and part of the lower part) contained the warhead. Immediately behind it were the control systems. It is noteworthy that the R-27 rocket did not have an instrument compartment in the usual sense of the word. The control equipment was placed not in a separate compartment of the body, but in a small sealed volume formed by the bottom of the wa and the hemispherical upper bottom of the oxidizer tank.

Most of the volume of the hull was allocated for fuel and oxidizer tanks. An important feature of the tanks was the use of common walls, which also served as a supporting body. The internal volume of the tank body was divided by several bottoms. One divided the oxidizer tank into two volumes, and the second, which had a double design, separated the oxidizer and fuel tanks. This technical solution made it possible to abandon the intertank compartment and thereby further reduce the length of the rocket.



Another solution aimed at reducing the dimensions of the product was the original placement of the engine. The fuel tank received a bottom bottom of a complex shape, which made it possible to “drown” the engine inside the tank. This led to an additional reduction in the dimensions of the rocket without deteriorating other characteristics.

Especially for the new rocket at OKB-2 under the leadership of A.M. Isaev developed a 4D10 liquid engine running on unsymmetrical dimethylhydrazine and nitrogen tetroxide.The engine design included a propulsion unit with a thrust of 23 tons and a steering rod of 3 tons. The engine was equipped with turbopump units for supplying fuel and oxidizer. The propulsion engine block used afterburning of oxidizing gas and was equipped with a fuel flow regulator, with the help of which the thrust was to be changed. The steering unit did not burn out the oxidizing gas, and its thrust had to be adjusted by changing the supply of oxidizer to all chambers. For control, oscillating steering block cameras were used, mounted at an angle of 45° to the rocket stabilization planes.



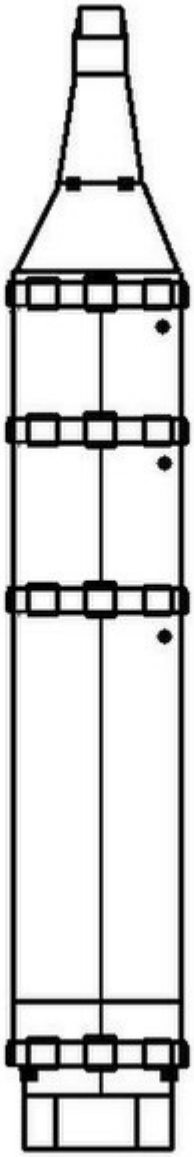
In order to simplify the design and improve performance characteristics, the engine was made maintenance-free. When installing the engine, it was proposed to use only permanent connections, such as soldering or welding. This design required the development of a set of special adapters of a bimetallic design, consisting of steel and aluminum parts. To start, the engine was equipped with a single squib and its own automation necessary to bring it to operating mode.

For the first time in domestic practice, a ballistic missile for the fleet had to be refueled at the manufacturer. It was proposed to fill in the fuel and oxidizer at the final stage of assembly, after which the filling and drainage pipes had to be welded. The ampulized missile could be stored at bases and launchers for five years. Subsequently, taking into account the operating experience of the new weapon, the shelf life was tripled.

Another innovation concerned the design of the control system. The autonomous inertial guidance system was placed in a sealed volume formed by the bottoms of other units. At the same time, the R-27 became the first domestic missile for submarines, the control system of which used a gyro-stabilized platform. The latter was used to install sensitive elements that monitor the position of the product in space. A guidance system with improved characteristics made it possible to fire from a CEP of no more than 1.9 km when launched at maximum range.

For the R-27 missile, NII-1011 developed a special warhead weighing 650 kg with a power of 1 Mt warhead was made detachable using an extended high explosive charge. When creating a new warhead, the designers had to face some layout problems. Nevertheless, all the tasks were successfully

solved, which resulted in the emergence of a new type of warhead, differing from the previous product for the R-21 missile in approximately half the dimensions without loss of power.



The new ballistic missile differed from existing products of a similar purpose in its smaller dimensions. The length of the R-27 did not exceed 9 m, the diameter was 1.5 m. The launch mass was 14.2 tons. The liquid engine could accelerate the rocket to a speed (at the end of the active phase) of 4.4 m/s, bringing it to an altitude of up to 120 km . After completing the active section, the warhead was to be reset, continuing its flight on its own. The maximum firing range was 2500 km, with the warhead rising to a height of 620 km. When meeting a target, the warhead developed a speed of up to 300 m/s.

To use R-27 missiles, the carrier submarine had to receive a new type of silo launcher. This unit was a durable cylindrical block with an openable top cover and a set of necessary equipment. The launcher received a launch pad of a new design, which was supposed to be connected to a special adapter in the tail of the rocket. The task of these units was to create the so-called. gas bell, which, when started, reduces the pressure inside the shaft to acceptable values. The launcher also had a set of sealed connectors for connecting the rocket with the onboard equipment of the carrier.

The carrier submarine was to receive a set of special equipment designed to monitor the status of the missiles. At the same time, all parameters were controlled from a single remote control. Carrying out routine checks, pre-launch preparation and shooting were controlled from another remote control.To develop a flight mission and enter data into missile control systems, the “Tucha” combat information and control system was proposed.

The R-27 missile had the ability to launch underwater using a “wet” scheme. Before launching, i necessary to fill the annular gap of the launch shaft with sea water, after which it was possible to open

the lid and launch. During the launch, the liquid engine had to start the steering motors, with the help of which a gas bell was created. After the ascent began, the propulsion engine had to be turned on, with the help of which the rocket could leave the silo and fly out of the water.

Testing of the new rocket was planned to be carried out in three stages, the purpose of which was to test the product in various conditions. The first tests took place in September 1965 using a submersible stand. Two (according to other sources, up to six) full-scale mock-ups of the R-27 missile were used in throwing tests, during which the process of the missile exiting the silo was checked.

In June 1966, the second stage of testing began, lasting until the spring of 1967. At the Kapustin [illegible]st site, 17 launches of experimental missiles were carried out against conditional targets. 12 launches

were considered successful. Completion of tests with a ground-based launcher allowed testing to begin using submarines.

Back in 1964, modernization of the S-229 submarine began, which at that time was a representative of the experimental project 613D7 and was used as an experimental carrier of the RT-15M missile, according to project 613D5. The existing launcher was removed from the boat, and a smaller silo for the R-27 missile was installed in its place. In addition, it received a set of new equipment necessary for the maintenance and use of such missiles. In January 1967, the S-229 went to sea for the first time to test new weapons.

On January 18, the S-229 submarine, being at a depth of 45 m and moving at a speed of 3 knots, launched a full-scale prototype of the R-27 missile for the first time at a sea level of 3 points.Until August 10 inclusive, five more launches were carried out. All tests using the Project 613D5 boat were successful.

In the summer of 1967, the third stage of testing began, in which the standard carrier of the D-5 complex was used - the K-137 Leninets nuclear submarine of Project 667A Navaga. Launches began in August, during which six missiles were used. These joint state tests were completed successfully, after which the D-5/R-27 missile system was recommended for adoption.

On March 13, 1968, the new missile and its complex were adopted by the submarine forces of the [illegible] Navy. By this time, full-scale serial construction of Project 667A submarines had begun. Such

submarines carried 16 launchers located in two rows along the hull in the fourth and fifth compartments. Until the mid-seventies, the fleet received 34 Navaga-class submarines of several modifications, which were distributed among various formations.In total, they could simultaneously carry 544 R-27 missiles.

Since the early sixties, the anti-ship R-27K was developed on the basis of the R-27 ballistic missile. Such a product received a semi-active radar guidance system and could hit moving targets in the form of enemy naval formations. The R-27K project reached testing, but did not lead to the rearmament of the fleet and the expansion of the list of strike weapons. The new weapon was considered inconvenient and could have a negative impact on nuclear forces: submarines were required to deploy anti-ship ballistic missiles, which could affect the number of deployed strategic weapons. After completion of the test, the R-27K was abandoned, although work on similar systems continued.

In June 1971, the Council of Ministers issued a resolution on the modernization of the D-5 complex with the R-27 missile. It was necessary to create two options for upgrading the missile, one of which was supposed to use a multiple warhead with multiple warheads, and the second meant increasing the flight range.The updated complex was designated D-5U, the missile for it was designated R-27U.

The first modernization option implied maintaining all the design features of the base rocket while using a new warhead. On a general basis, it was now proposed to mount three dropable warheads with a capacity of 250 kt each. At the end of the active phase of the flight, the rocket was supposed to drop its warheads and give them a small lateral speed. It was assumed that in this case, warheads of reduced power would fly at a certain distance from each other and fall in the target area, to a certain extent increasing the likelihood of effectively hitting it.

The R-27U missile of the second version received a lightweight warhead with a capacity of 1 Mt, thanks to which the firing range was increased to 3000 km. The operating principles of the rocket systems remained unchanged, although some design modifications were required.

An updated control system was developed for two versions of the R-27U missile.Due to the improvement of its instruments, the CEP was reduced to 1.3 km. In this case, the power of the warhead fully compensated for the miss and guaranteed hitting the target.

From September 1972 to August 1973, flight tests of new missiles were carried out. Based on the test results, in early January 1974, the D-5U missile system and the R-27U product were put into service. In this regard, the D-5U complex during construction was installed on four boats of the updated project 667AU “Nalim”. Eight more carriers of the new missiles were converted from Project 667A boats

The last modernization of the D-5 missile system was carried out in the early eighties. The R-27 missile in its basic configuration was re-equipped with a lightweight monoblock warhead from the R-27U product. This made it possible to increase the firing range to 3000 km. A similar modernization of the complex is known as D-5M.

Full operation of the D-5 family of missile systems continued for two decades, until 1988.During this time, fleet specialists performed more than 10 thousand missile loading and unloading operations to ensure 590 submarines went on combat duty. 492 missile launches were carried out, of which 429 resulted in the successful defeat of training targets. In 1971, nuclear submarines of the 667A family set a record with a total of 58 launches. This achievement has not yet been surpassed. On average, 23.4 missiles were used per year. Of the 492 launches, 161 were on D-5U complexes. R-27U missiles completed assigned combat training tasks 150 times.

Of particular interest are the combat training events carried out twice by submariners of the Northern and Pacific fleets. On December 20, 1968, the K-140 submarine of the Northern Fleet fired a salvo of eight missiles (according to other sources, two salvos of eight missiles each). Subsequently, one of the Pacific Fleet boats carried out a similar shooting.

Unfortunately, there were accidents and losses. The first serious incident (the exact location and date of the incident is unknown, probably the early seventies) led to the death of two people.During loading of the missile onto the carrier submarine, due to incorrect actions of the personnel and imperfections in the design, the product and the loading beam were misaligned. The misalignment led to the rocket breaking off its mountings and falling onto the pier. The fuel tank survived, but a hole appeared in the oxidizer tank. Two participants in the work were poisoned by oxidizing vapors. Based on the results of this incident, the missile loading system was modified.

In 1976, an accident occurred on the submarine K-444, but its crew managed to prevent negative consequences. Due to improper preparation of three R-27 missiles for launch, the silo was filled with sea water and the structure of the tanks was damaged. After surfacing and draining the mine, this led to an oxidizer leak. The crew took the necessary measures and prevented a fire.

Two accidents occurred on the Project 667A submarine K-219, and the second led to its loss. In 1973, the launcher's automation allowed the silo filling valves to open, which led to damage to the rocket by seawater pressure.When draining the launcher, fuel components leaked from the damaged tanks and caught fire, but automatic irrigation prevented the fire from developing. The submarine returned to base and underwent repairs.

On October 3, 1986, K-219 again encountered problems. For unknown reasons, when the boat was submerged, water began to penetrate into one of the launch shafts. The crew's attempt to drain the

mine using non-standard means with the automation switched off was unsuccessful, but led to an increase in pressure and destruction of the rocket. This time, the turned off automatic irrigation system could not prevent the fire. The fire led to an explosion with the launcher cover being torn off and the fire spreading to the fourth compartment. Due to the impossibility of extinguishing the fire on their own, the crew was forced to evacuate and scuttle the boat. Three submariners died in this accident.

It should be noted that, despite all the incidents, the D-5 / R-27 missile system proved to be an effective and reliable weapon for submarines.At the end of the eighties, the removal of the complexes and their carriers from service began due to moral and physical obsolescence, as well as due to the signing of new international agreements. Thus, in connection with the implementation of the START-1 treaty, by the end of the nineties, no more than 16 R-27 missiles were deployed in the submarine forces. Soon they were removed from service.
In the early nineties, the Zyb launch vehicle was developed on the basis of the ballistic R-27. The main task of these products was to carry special research equipment designed to work in microgravity conditions. It was possible to launch a cargo with a volume of 1.5 cubic meters weighing up to 1 ton into a suborbital trajectory. A 1000-kg cargo could reach an altitude of 1000 km, and a maximum altitude of 1800 km was achieved with a cargo weighing 650 kg.

On December 1, 1991, December 9, 1992, and December 1, 93, three launches of Zyb rockets were carried out with scientific equipment of different types and for various purposes. After this, the operation of the new type of launch vehicles ceased.

The D-5 complex and the R-27 missile, designed to arm submarines, were in operation for several decades and occupied an important place in the strategic nuclear forces of the Soviet Union. In addition, within the framework of this project, serious design and technological advances were achieved. In the R-27 project, for the first time in domestic practice, several important solutions were introduced, which later became a standard in the development of new ballistic missiles for submarines. In addition, the 667A submarine project was created for the D-5 complex, the further development of which made it possible to significantly strengthen the naval component of the nuclear triad and maintain its potential for a long time.

Military review.

Leave feedback:

Ballistic missile 4K10 R-27 (USSR)

SLBM R-27 (URAV Navy index - 4K10, START code - RSM-25) is a liquid-propelled single-stage ballistic missile for submarines.As part of the D-5 missile system, it was part of the armament of nuclear submarines of projects 667A and 667AU. The development of the rocket was specified by Decree of the Central Committee of the CPSU and the Council of Ministers of the USSR dated April 24, 1962 No. 386-179ss. SKB-385 was identified as the lead developer. Chief designer - V. P. Makeev. The main task in creating a missile system with the R-27 missile was to bridge the gap with American missiles of this class.

During the development of the rocket, a number of innovative solutions were used, which made it possible to significantly improve the characteristics of both the R-27 rocket and subsequent developments of the SKB-385. Thus, the entire internal volume of the rocket was used to the maximum to accommodate fuel components - there was no traditional division into compartments, and the main engine was located in the fuel tank (the so-called “drowned”). The all-welded sealed body was made of wafer shells obtained by chemical milling of plates, the material for which was an aluminum-magnesium alloy.The volume of the air bell was reduced due to the sequential start-up of the steering engines, and then the main engine. And a number of other innovations. All these innovations made it possible to reduce the dimensions of the missile, but double the maximum firing range compared to the R-21 missile.

The R-27 missile was made according to a single-stage design with a monoblock detachable warhead. The rocket was equipped with a 4D10 liquid rocket engine developed by OKB-2, which consisted of two blocks: a propulsion block with a thrust of 23 tons and a steering block of two chambers with a total thrust of 3 tons. Unsymmetrical dimethylhydrazine (UDMH) was used as a fuel, and nitrogen tetroxide (AT) was used as an oxidizer. For the first time in the USSR, elements of the inertial control system (for SLBMs) were placed on a gyro-stabilized platform. The rocket was equipped with a monoblock detachable warhead weighing 650 kg. The power of the nuclear charge placed on it was 1 megaton. The missiles were launched from a depth of 40-50 meters at a boat speed of up to 4 knots and a sea state of 5 points.Pre-launch preparation time for rockets is 10 minutes. The firing interval of missiles in one salvo is 8 seconds.

The R-27 missile was put into service on March 13, 1968. Three years later, on June 10, 1971, a resolution was adopted by the Central Committee of the CPSU and the Council of Ministers of the USSR on the modernization of the missile system, which in the first version provided for equipping the missile with a warhead with three warheads, while maintaining the maximum firing range, and in the second

version - increasing the range and increasing shooting accuracy. The upgraded missile received the designation R-27U (GRAU code - 4K10U). As a result of the work carried out, a missile was created with three warheads with a capacity of 200 kilotons each with a maximum firing range of 2,400 kilometers. The splitting warhead did not have individual guidance - at the end of the active section, the blocks were “pushed” in different directions at low speed. According to the second option, a missile was created with a firing range of 3000 kilometers and a monoblock warhead with a capacity of 1 megaton. The circular probable deviation was 1.3 kilometers.

Ship tests of R-27U missiles took place from September 1972 to August 1973. 16 launches were carried out, all of them were considered successful. The R-27U missile was adopted for service by Decree of the Central Committee of the CPSU and the Council of Ministers of the USSR dated January 4, 1974 No. 8-5ss. The missile system with R-27U missiles was equipped with Project 667AU nuclear submarines under construction, as well as Project 667A boats after modernization.

The resolution of the Central Committee of the CPSU and the Council of Ministers of the USSR dated April 24, 1962 on the creation of the R-27 missile also provided for the development of a missile with a homing warhead capable of hitting moving ships. The anti-ship version of the missile was designated R-27K (GRAU index - 4K18). The rocket was equipped with a 2nd stage with a liquid rocket engine developed by OKB-2. To maintain the dimensions of the missile, the dimensions of the 1st stage were reduced, which ultimately led to a reduction in the maximum firing range to 900 km.The warhead is monoblock, nuclear, with a capacity of 0.65 megatons. Despite the relatively early start of development of the R-27K missile, its testing began only in December 1970. The ground test cycle at the Kapustin Yar test site included 20 launches. Of these, 16 were considered successful.

To accommodate Project 605 missiles, the K-102 Project 629 submarine was converted. The first launch from the submarine was carried out in December 1972. And in November 1973, the tests ended with a two-missile salvo. A total of 11 launches were carried out, of which 10 were considered successful. During the last launch, the target ship was hit by a direct hit from a guided unit. The R-27 missile was in service until 1988. During this period, 492 missile launches were carried out, of which 429 were considered successful. The maximum number of launches was in 1971 - 58. This is a kind of record for Soviet and Russian ballistic missiles from submarines. The complex also holds the record for the average annual number of launches - 23.4 launches.

Over the years it has been in service, 161 R-27U missiles have also been launched. Of these, 150 launches were successful. The last launches of R-27 and R-27U missiles according to combat training plans were carried out in 1988. After this, launches were carried out only for research purposes. During the missile's operation, 8 missiles were fired in one salvo twice (once each in the Northern and Pacific fleets). All launches were considered successful. The R-27U missile was withdrawn from service in 1989. The Zyb launch vehicle was developed based on the R-27U SLBM.

Technical characteristics of 4K10 R-27
Length, m 8.89
Diameter, m 1.5
Launch weight, t 14.2
Warhead weight, t 0.65
Maximum range, km 2500
Circular probable deviation, km 1.9
Warhead type - mono
Head power, Mt 1

authors of the article: A.B. Zheleznyakov
primary source: “100 best missiles of the USSR and Russia”

R-27K anti-ship ballistic missile

Modern strike systems designed to destroy enemy surface ships are based on cruise missiles of various types.Such weapons have long shown themselves to be good and enjoy deserved popularity. However, there have been numerous attempts in the past to develop an anti-ship system based on a ballistic missile. Most of these projects did not lead to the rearmament of the armed forces, but they provided important experience. The first domestic anti-ship ballistic missile was the R-27K product. In April 1962, the USSR Council of Ministers decided to begin development of a new medium-range ballistic missile intended for use by submarines. The missile system project received the designation D-5, the missile itself - R-27. Miass SKB-385 (now the State Missile Center) was appointed as the project developer; V.P. was to supervise the work. Makeev. Work on the D-5/R-27 project led to the adoption of a new missile system for submarine service in 1968.

Also in 1962, a proposal appeared to develop a modification of the R-27 missile, designed to destroy moving surface targets at ranges of up to 900 km.The anti-ship missile called R-27K or 4K18 was supposed to be based on the units of the R-27 product, but had a different purpose. Due to the need to destroy small moving targets, the anti-ship missile had to receive a set of new equipment, including a homing system.

R-27K missiles on a test bench. Photo Rbase.new-factoria.ru

Calculations showed that existing detection systems make it possible to determine the location of surface targets with an accuracy of 25-30 km. Moreover, during the pre-launch preparation of the rocket, the target could move 100-150 km from the previously determined point. Thus, an anti-ship ballistic missile had to be equipped with homing systems to independently determine the current location of the target.

Already in 1962, the general architecture of the new product was proposed, which made it possible to solve the problem. It was proposed to rework the existing rocket and make it a two-stage one.The task of the first stage in this case was the initial acceleration and launch of the missile onto the required ballistic trajectory, and the second stage was supposed to find and hit the target. In addition, the preliminary design of the first version proposed ways to solve the basic problems of finding targets and targeting them.

It was proposed to use the second stage in the form of a streamlined unit with a radio-transparent head section and a passive side-view radar system. Using a folding cross-shaped side-view antenna, it was proposed to search for signals from the ship's radio-electronic systems, and final guidance was to be carried out using a passive radar seeker. It was also proposed to use rather complex control equipment with gyroscopic devices, etc.

Early work on the R-27K project led to the formation of a range of main problems that needed to be solved to create the rocket. First of all, it was determined that the second stage of the rocket with guidance systems was too large.It can occupy up to 40% of the dimensions of the entire rocket, which would require reducing the size of the first stage and reducing the volume of its tanks. In this case, the flight range was significantly lower than required. In addition, the second stage guidance systems required a heat-resistant fairing capable of transmitting radio signals. The required materials with such characteristics were not available at that time, and their creation required time and additional research.

Basic version R-27 missile on a transport trolley. Photo Rbase.new-factoria.ru

Probably, it was the lack of ready-made developments for the manufacture of a radio-transparent fairing that led to the fact that in 1963 SKB-385 developed two versions of the R-27K missile with different versions of guidance systems. Both pre-design designs used a unified first stage based on the base R-27 units. The stage received a shortened body with tanks for fuel and oxidizer, and was also supposed to be equipped with a liquid engine, unified with the R-27.On top of the first stage, the second

was to be installed, which had its own control systems, engine, etc.

The early Project A variant, developed in 1963, involved ballistic and aerodynamic flight control. After dropping the first stage, the missile, using a side-view antenna, was supposed to receive signals from the target ship and determine its location. Then a ballistic course correction was made, for which short-term activations of the second stage engine were used. With one or two engine starts (the fuel supply was limited), the second stage had to reach the required trajectory.

Having passed the upper part of the ballistic trajectory, the missile was supposed to turn on the passive radar homing head, find the target and fly towards it. For control in the atmosphere it was proposed to use aerodynamic rudders. This version of two-stage ballistic-aerodynamic guidance made it possible to ensure the highest hit accuracy and made it possible to use a less powerful warhead.

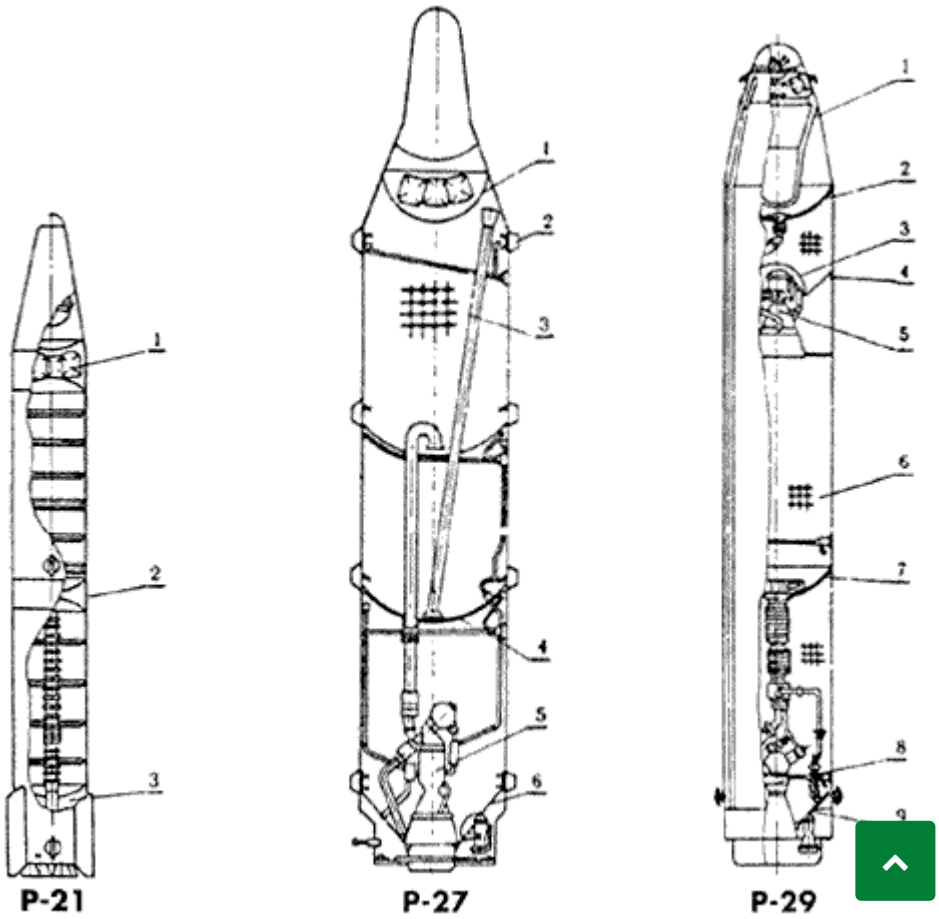
Option "B" suggested the use of ballistic course correction only. During the exoatmospheric portion of the flight, the rocket had to find the target using a side-view antenna, calculate the required trajectory and reach it. After re-entry, no course correction was provided. Ballistic guidance reduced accuracy and required a more powerful warhead. Moreover, such a guidance system was simple and did not require reducing the dimensions of the first stage beyond the permissible limits, allowing the re launch range to be achieved.

Option “A” of the preliminary design. Drawing Otvaga2004.ru

After analyzing two preliminary projects, it was decided to abandon the two-stage guidance. The implementation of ballistic and aerodynamic course correction was associated with a lot of problems and could not be implemented to the fullest extent. For this reason, project “A” was abandoned, and the development of option “B” continued. It was proposed to determine the target using a passive side-view radar system.The second seeker for searching for targets on the descending leg of the flight was abandoned.

NII-592 was involved in the creation of a guidance system for the 4K18 product. The finished control system was based on a semiconductor element base and was supposed to solve the problem of finding a target with the subsequent calculation of the flight path to it. The general features of the work were determined in accordance with the preliminary design. At the same time, some new solutions were proposed. To search for targets, it was proposed to use a passive radar GSK with a cross-shaped receiving antenna. During transportation and during the initial phase of the flight, the antenna had to be located in the cylindrical compartment of the second stage body. After entering the trajectory correction section, the missile had to extend and unfold the antenna to search for target signals.

Having found the target and calculated the optimal trajectory to hit it, the second stage of the rocket had to adjust its course using the existing engine. The fuel supply allowed the engine to be turned on twice.After course correction and braking, the second stage was supposed to move to the descending section of the trajectory and follow the target.



The finished project of the R-27K rocket implied the construction of a two-stage product based on the units of the basic R-27 rocket. The anti-ship missile had a length of about 9 m and a diameter of 1.5 m. The launch weight was 13.25 m. The

new modification of the missile had a distinctive appearance. It received a head part of a complex shape, formed by several conical and cylindrical surfaces. The complex head fairing was longer in comparison with the units of the basic R-27 rocket.

Option "B" of the preliminary design. Drawing Otvaga2004.ru

The first stage, reduced in length and with a reduced supply of fuel and oxidizer, was equipped with a 4D10 liquid engine developed at OKB-2. The engine included a propulsion block with a thrust of 23 tons and a steering system of two separate chambers with a total thrust of 3 tons. The engine consumed fuel in the form of asymmetrical dimethylhydrazine and nitrogen tetroxide as an oxidizer.A curious feature of the power plant of the R-27 and R-27K missiles was the placement of the engine. For the first time in domestic and foreign practice, to save space, the engine was placed inside the fuel tank.

The 4K18 missile could be launched using a standard silo installation of the D-5 complex, developed for submarines of several projects. Before launch, the mine had to be flooded, and in addition, the tanks had to be pressurized to compensate for the pressure. When leaving the launcher, the missile had to be in the so-called. gas bell, which reduced the impact of surrounding water. After rising to the surface, the missile continued its flight to the target using existing guidance systems.

Reducing the first stage and the volume of fuel tanks led to a significant reduction in flight range compared to the basic rocket. The R-27 could fly to a range of up to 2,500 km to destroy ground targets, while the anti-ship R-27K was capable of attacking targets only from 900 km.

It was proposed to hit the target using a monoblock special warhead with a power of 650 kt. Such a nuclear warhead made it possible to compensate for the insufficiently high accuracy of targeting and ensure effective destruction of enemy surface ships.

Comparison of R-27K (left) and R-27 (right) missiles. Drawing by Shirokorad A.B. “Weapons of the domestic fleet. 1945-2000"

For initial target designation, it was proposed to use existing and future surface object detection systems. During the development of the R-27K project, the “Success” system was in service, based on reconnaissance aircraft. In the future, it was planned to put into operation the Legend system with radar reconnaissance spacecraft. The appearance of the latter made it possible to use 4K18 missiles with maximum efficiency.

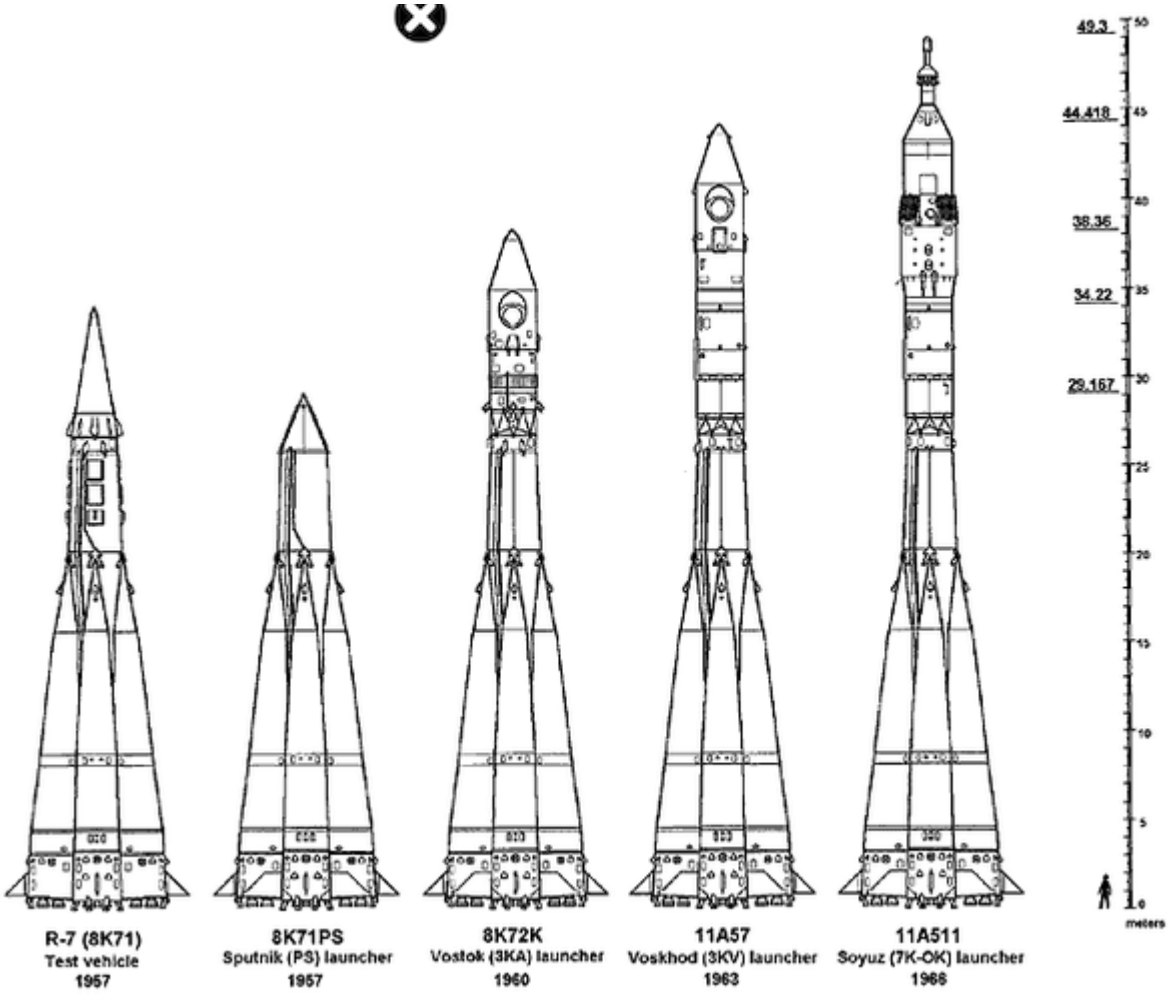
The main task of SKB-385 was the development of the basic R-27 project. Because of this, the anti-ship weapon project was created with a significant lag behind it.As a result of this lag, the D-5 missile system with the R-27 missile was put into service in 1968, and testing of the 4K18 missiles began only

in 1970. One of the reasons for this lag was difficulties with the development of certain elements of the anti-ship missile.

In December 1970, the first test launch of the R-27K missile took place at the Kapustin Yar test si

These tests used a stationary ground stand. Over the next few months, 20 launches were carried out. 16

launches were counted, while the rest ended in failure. Soon, several throw launches were carried out using a



submersible stand. During such checks, the product entered from the launcher of a submarine in a submerged position.

Since the mid-sixties, the issue of choosing a submarine to carry new anti-ship ballistic missiles has been resolved. The D-5 complex with the R-27K missile was proposed to be used with several types of submarines. However, only projects 667A, 687 and 705B have progressed beyond preliminary work. Such submarines were supposed to carry from 4 to 16 missiles of a new type. Later, during the development of all projects, certain problems arose. Thus, the Project 667A nuclear submarines delivered to the series were now only supposed to participate in strategic nuclear forces, and their use as 4K18 carriers was considered inappropriate and unacceptable from the point of view of strike potential. Projects 687 and 705B, in turn, encountered numerous technical problems. As a result, three projects were never implemented.

Diesel-electric submarine project 629/605. Figure Wikimedia Commons

By the beginning of the seventies, the issue of the carrier of new missiles had not been resolved, but tests with launches from a submarine were approaching. Because of this, it was decided to involve one of the existing submarines in testing. The diesel-electric submarine K-102 of Project 629 was ch[illegible]s an experimental vessel for testing a new type of missile. It was proposed to re-equip it accordin[illegible]e

new Project 605, which proposed the installation of four launch silos and a number of other equipment. In particular, the navigation complex and target designation system were updated.

On December 9, 1972, the K-102 submarine launched the R-27K missile for the first time. In about a year of testing, 11 missiles were used up, which were used to attack various targets. Of particular interest is the last launch, which took place on November 3, 1973. This time, two 4K18 missiles were launched at a target in the form of a barge with a radar station. One of the fired missiles successfully aimed at the target and hit it with a direct hit. The second reached the target area with a permissible deviation from it. It is noteworthy that by the time the missiles launched, the uncertainty in the target position reached 75 km. Despite this, the passive homing system detected the target and destroyed it. In general, the tests were successful. 10 out of 11 launches were considered successful.

On September 2, 1975, after completion of all design and test work, a decree was issued to close the R-27K project. Such weapons were of some interest to the fleet, but there were a number of characteristic shortcomings that interfered with their operation.Thus, the nuclear warhead made it difficult to deploy submarines with new types of missiles in the light of the new SALT II treaty. The passive radar guidance system did not provide high enough guidance accuracy, and countering it was quite si
To disrupt the attack, enemy ships simply had to turn off their radar equipment for a while. Finally, by the mid-seventies, significant advances had been made in the field of anti-ship cruise missiles.

A number of reasons made the new R-27K project useless and unpromising. Because of this, all work on the new missile was stopped and it was not accepted for service. As a result, the navy did not receive new unusual weapons and continued to use existing systems of a more familiar appearance. At the same time, however, the K-102 boat with the D-5 complex remained in trial operation until the early eighties.

The first domestic project of an anti-ship ballistic missile ended in a successful solution to all the assigned tasks, but was not brought into service by the troops.The reason for this was some problems of the project, including those that were fundamentally irremovable. Subsequently, Soviet specialists made another attempt to create similar weapons. The new anti-ship ballistic missile was to be a product of the R-33 type, based on the design of the R-29 missile.

Based on materials from:

http://makeyev.ru/

http://otvaga2004.ru/

http://alternathistory.com/

http://rbase.new-factoria.ru/

http://deepstorm.ru/

Shirokorad A. B. Weapons of the domestic fleet. 1945-2000. – Mn.: “Harvest”, 2001

A message from the depths. How the deadliest submarine weapon works

https://ria.ru/20191020/1559926828.html

A message from the depths. How the deadliest submarine weapon works

A message from the depths. How the deadliest submarine weapon works

Stealthy, powerful, long-range - submarine-launched ballistic missiles (SLBMs) remain the main striking force of the fleets of nuclear powers. In the USA, more than half of all... RIA Novosti, 20.10.2019

2019-10-20T08:00

2019-10-20T08:00

2019-10-20T08:06

Dmitry Donskoy

Alexander Nevskiy

Project 955 Borey submarines

safety

/html/head/meta[@name='og:title']/@content

/html/head/meta[@name='og:description']/@content

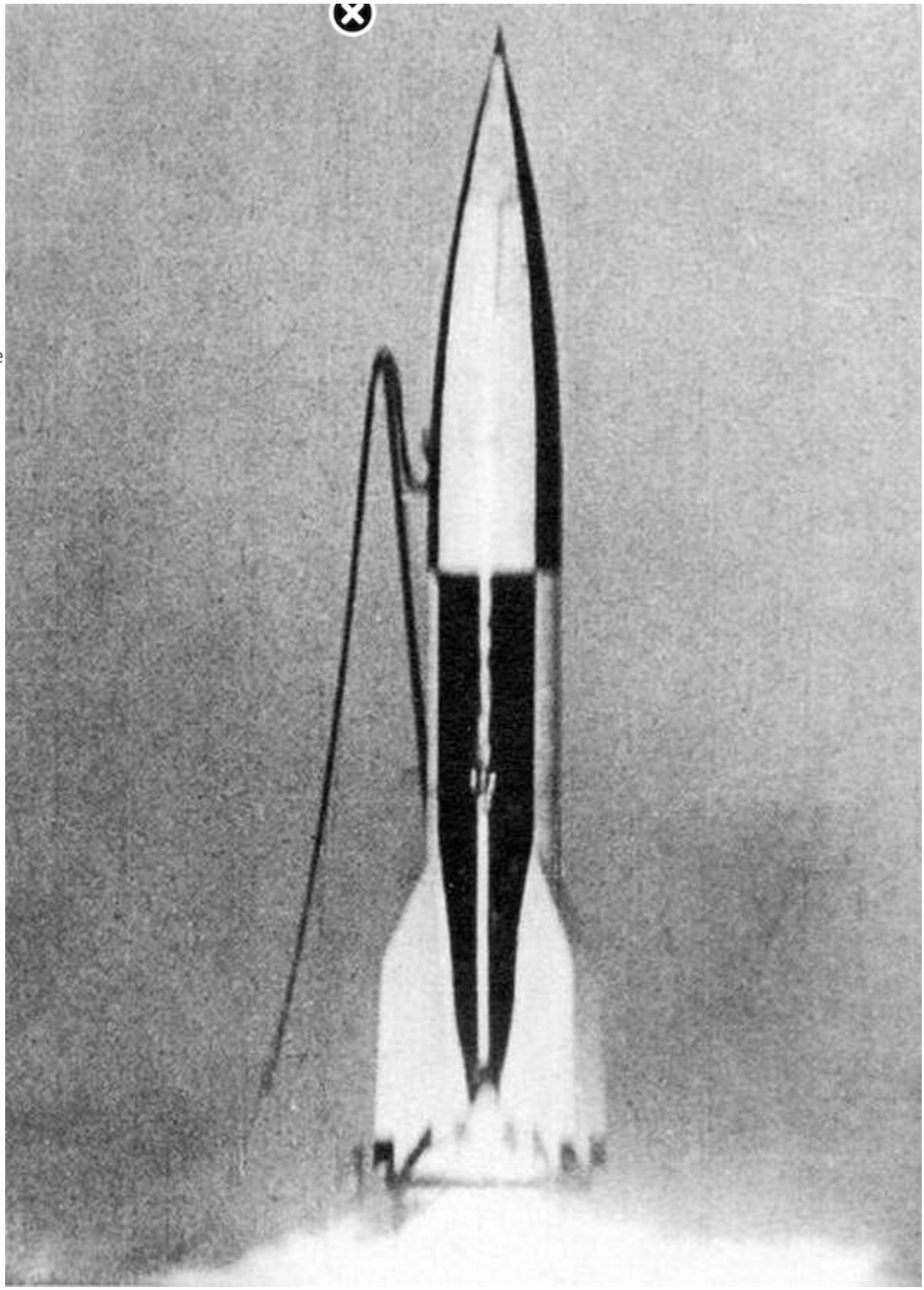
https://cdn22.img.ria.ru/images/155794/01/1557940120_0:52:1000:615_1920x0_80_0_0_2df2947c31b84e4573

MOSCOW, October 20 - RIA Novosti, Andrey Kots. Stealthy, powerful, long-range - submarine-launched ballistic missiles (SLBMs) remain the main striking force of the fleets of nuclear powers. In the United States, more than half of all strategic warheads are deployed on nuclear submarines. Russia relies mainly on “land-based” intercontinental missiles, but it is also in no hurry to write off SLBMs. Read about how this type of weapon developed and why it is the future in the RIA Novosti article. First launch The idea of deploying ballistic missiles on underwater carriers matured in the minds of Soviet gunsmiths by the mid-50s.The USSR and the USA hastily developed new means of delivering nuclear weapons to enemy territory. By that time, serial intercontinental missiles had not yet been produced, but both sides had accumulated considerable experience in the construction of medium-range missiles. The new concept provided for their placement on board submarines, which would secretly approach the enemy’s coast and fire a crushing salvo. In the fall of 1954, the first naval missile R-11FM, a modification of the “land” R-11, was launched from the Kapustin Yar test site. A year later, the completed SLBM was launched for the first time in history from the B-67 submarine. She flew o 0 kilometers, but this was enough to understand: nuclear weapons on submarines have a great future.

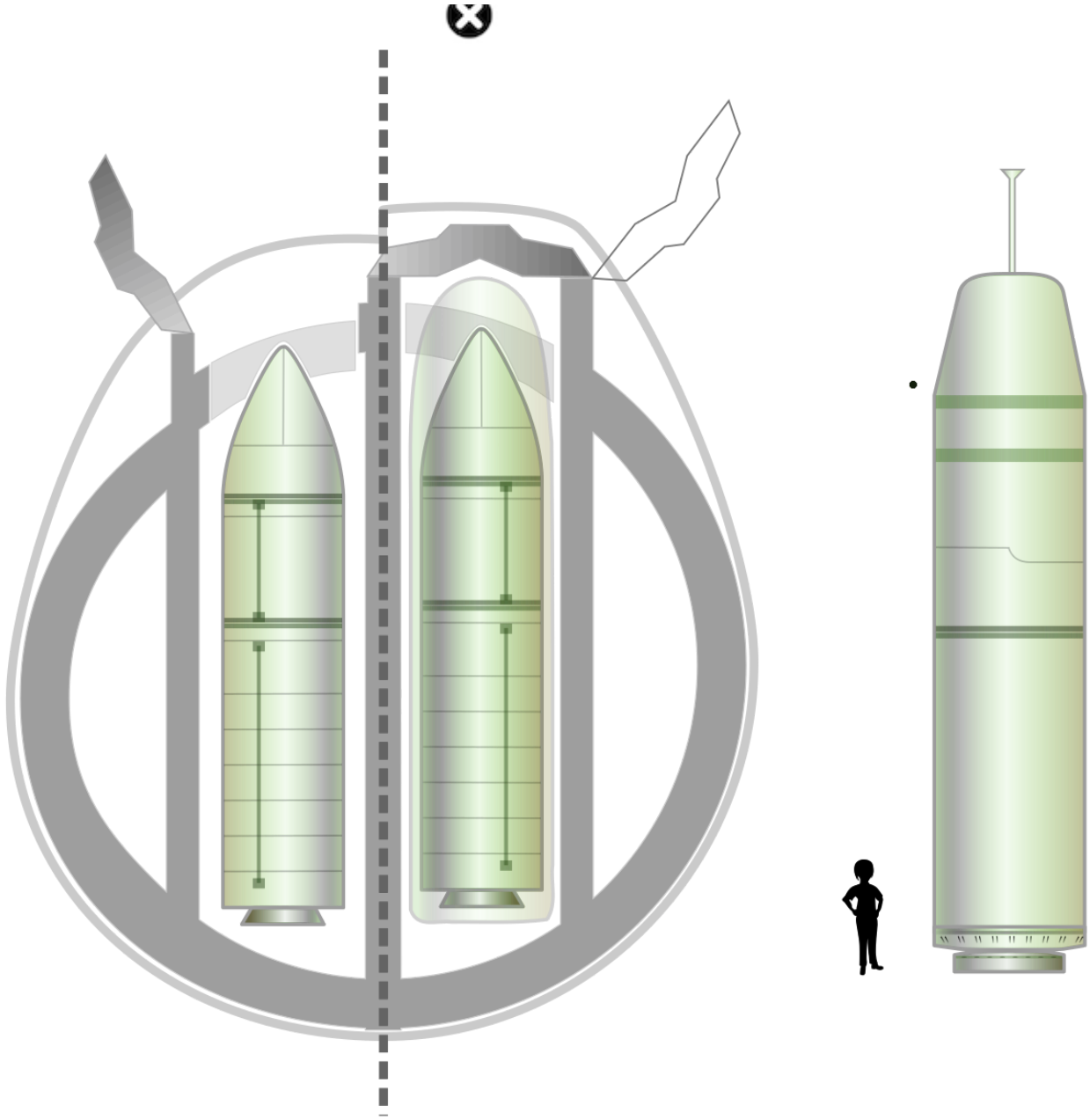
The USSR acquired new capabilities for striking the territory of Western Europe and the United States. Early SLBMs, both Soviet and American, had one significant drawback. Boats could only fire them from the surface. In addition, a lot of time was spent preparing for the start.This made strategic

submarines easy targets for aircraft and surface ships. The first Soviet submarine-launched missile was the R-21, which entered service in 1963. At that time it was a real breakthrough. The flight range was 1,300 kilometers when equipped with a one-megaton warhead and 1,600 kilometers with an 800-kiloton warhead. An inertial control system with improved characteristics provided a probable deviation coefficient of 2.8 kilometers. However, the main advantage of the missile was the ability to launch from a depth of 40 meters. “Wet” versus “dry” Despite its decent characteristics, the R-21 was significantly inferior to the American Polaris-A1 (range 2,200 kilometers) and Polaris-A2 (2,800 kilometers) missiles). To close the gap, a new medium was needed. A few years later, the USSR tested the R-27, capable of throwing a megaton nuclear charge over a distance of up to 3,000 kilometers. The launch was carried out through the so-called “wet launch”.At the bottom of the R-27 there was a special adapter, with the help of which it was docked with the launch pad. During preparation, the tanks were pressurized, water entered the shaft, and the pressure was equalized with the outboard pressure. Then the lid was opened and the main engine was turned on. All domestic liquid SLBMs were distinguished by “wet start”. However, this method has disadvantages. Filling the shafts with water takes time and creates acoustic noise. If a submarine is being pursued by an anti-submarine ship, it is able to quickly take direction and destroy it. Solid propellant rockets are good because they can perform a “dry launch”. They are fired from a shaft with a powder charge, and the engine is turned on above the surface of the water. This method is quieter and faster, thanks to which the chances of a successful launch increase dramatically. Solid propellant SLBMs include the Soviet R-31 SLBMs with a range of up to 4,200 kilometers and R-39 (8,250 kilometers), as well as the newest R-30 “Bulava” (9,300 kilometers). For “Dolphins” and “Boreevs” Today, Russian nuclear-powered ships use several types of ballistic missiles.Firstly, these are liquid-fueled two-stage R-29Rs, which are armed with the last remaining boat of Project 667BDR Kalmar in service - the K-44 Ryazan. These missiles can throw three warheads of 200 kilotons each over a range of 6,500 kilometers. Secondly, the family of liquid-fuelled

three-stage missiles R-29RM remains in the Navy's arsenal. They are armed with six



"strategists" of the 667BDRM "Dolphin" project - K-51 "Verkhoturye", K-84 "Ekaterinburg", K-114 "Tula", K-18 "Karelia", K-407 "Novomoskovsk" and the K -117 "Bryansk". Each boat has 16 mines. The R-29RM was put into service more than 30 years ago and modernized several times. The latest modification, Sineva, flies 11,550 kilometers. Warhead - up to ten individual targeting units with a capacity of 100 kilotons each or four warheads of 500 kilotons each with missile defense penetration equipmen Finally, the most modern strategic nuclear-powered ships - three boats of Project 955 "Borey" - K-535

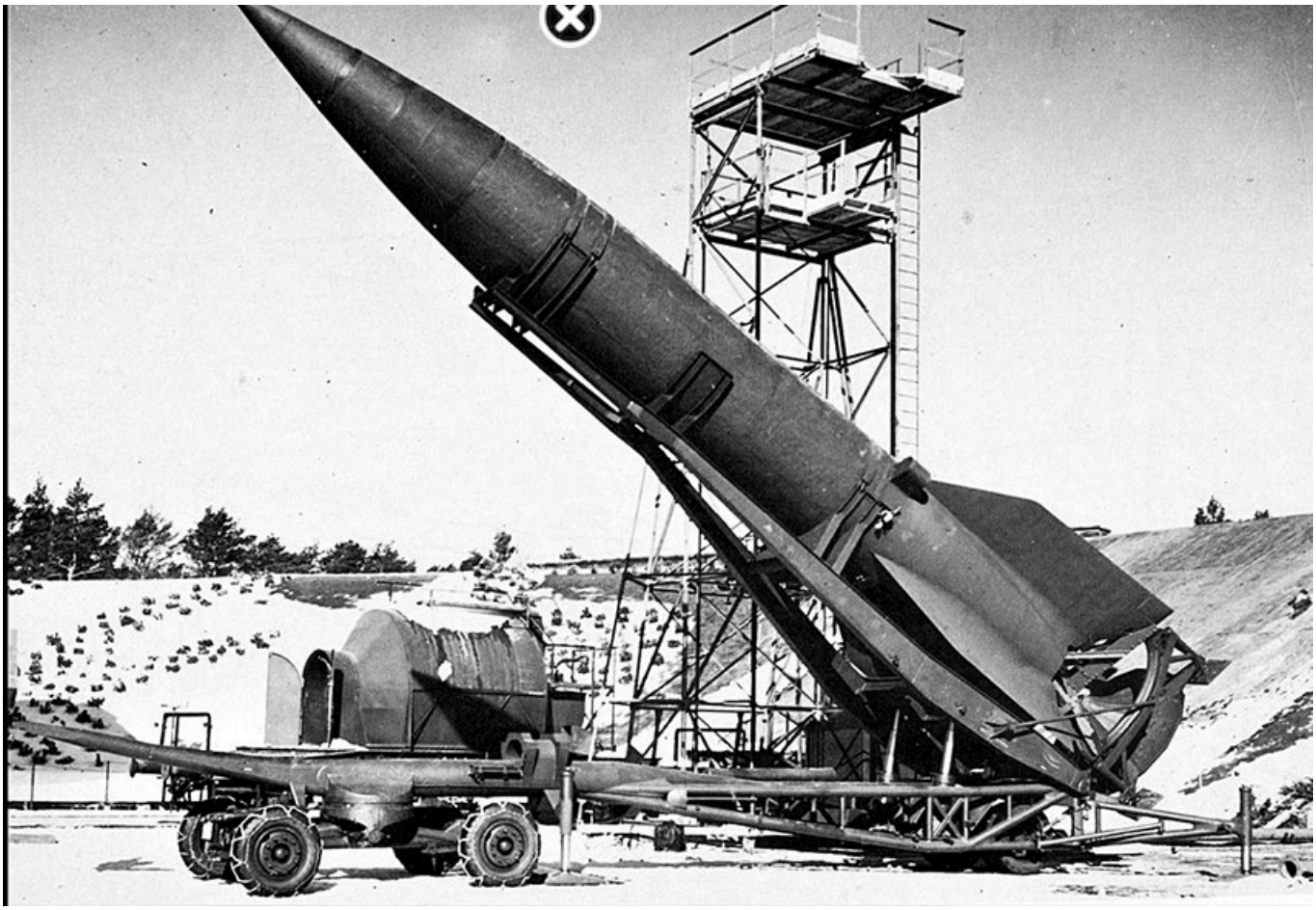


"Yuri Dolgoruky", K-550 " Alexander Nevsky" and K-551 "Vladimir Monomakh" - armed with R-30 "Bulava" solid-fuel ballistic missiles.In addition, the heavy submarine cruiser Dmitry Donskoy, the last representative of Project 941, was converted to use this SLBM. It carries 20 missiles, Borei - 16 each. Bulava was commissioned in 2018 after almost 15 years of testing."Bulava "Delivers six individually targeted warheads of 150 kilotons each. The probable deviation coefficient does not exceed 350 meters. The advantages of the new SLBM include a short booster active section. It is believed that this is where missiles are most vulnerable to missile defense systems. In addition, the Bulava can maneuver during acceleration, which protects it from kinetic interceptors designed for conventional ballistic trajectories.

https://ria.ru/20191001/1559289386.html

https://radiosputnik.ria.ru/20191017/1559899387.html

https://ria.ru/20190824/1557861229.html



RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn--p1ai/awards/

2019

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn--p1ai/awards/

News

ru-RU

https://ria.ru/docs/about/copyright.html

https://xn--c1acbl2abdlkab1og.xn--p1ai/

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn--p1ai/awards/

https://cdn22.img.ria.ru/images/155794/01/1557940120_57:0:945:666_1920x0_80_0_0_a216f6fea6b00b83319

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn--p1ai/awards/

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn--p1ai/awards/

Dmitry Donskoy, Alexander Nevsky, Project 955 Borei submarines, security

MOSCOW, October 20 - RIA Novosti, Andrey Kots. Stealthy, powerful, long-range - submarine-launched ballistic missiles (SLBMs) remain the main striking force of the fleets of nuclear powe the United States, more than half of all strategic warheads are deployed on nuclear submarines. Russia

relies mainly on “land-based” intercontinental missiles, but it is also in no hurry to write off SLBMs. Read about how this type of weapon developed and why it is the future in the RIA Novosti article.

First launch

The idea of deploying ballistic missiles on underwater carriers matured in the minds of Soviet gunsmiths by the mid-50s. The USSR and the USA hastily developed new means of delivering nuclear weapons to enemy territory. By that time, serial intercontinental missiles had not yet been produced, but both sides had accumulated considerable experience in the construction of medium-range missiles. The new concept provided for their placement on board submarines, which would covertly approach the enemy’s coast and fire a crushing salvo.

October 1, 2019, 08:00

Father of the apocalypse.The most large-scale projects of the Soviet designer Kozlov
In the fall of 1954, the first naval missile R-11FM, a modification of the “land” R-11, was launched from the Kapustin Yar test site. A year later, the completed SLBM was launched for the first time in history from the B-67 submarine. She flew only 250 kilometers, but this was enough to understand: nuclear weapons on submarines have a great future. The USSR acquired new capabilities for striking the territory of Western Europe and the United States.

Early SLBMs, both Soviet and American, had one significant drawback. Boats could only fire them from the surface. In addition, a lot of time was spent preparing for the start. This made strategic submarines easy targets for aircraft and surface ships.

The first Soviet submarine-launched missile was the R-21, which entered service in 1963. At that time it was a real breakthrough. The flight range was 1,300 kilometers when equipped with a one-megaton warhead and 1,600 kilometers with an 800-kiloton warhead.An inertial control system with improved characteristics provided a probable deviation coefficient of 2.8 kilometers. However, the main advantage of the rocket was the ability to launch from a depth of 40 meters.

"Wet" versus "dry"

Despite its decent characteristics, the R-21 was significantly inferior to the American Polaris-A1 (range 2,200 kilometers) and Polaris-A2 (2,800 kilometers) missiles. To close the gap, a new medium was needed. A few years later, the USSR tested the R-27, capable of throwing a megaton nuclear warhead over a distance of up to 3,000 kilometers.

17 October 2019, 15:09

Launches of ballistic and cruise missiles took place at the Grom-2019 exercises
The launch was carried out through the so-called “wet start”. At the bottom of the R-27 there was a special adapter, with the help of which it was docked with the launch pad. During preparation, the tanks were pressurized, water entered the shaft, and the pressure was equalized with the outboard pressure. Then the lid was opened and the main engine was turned on.

All domestic liquid-propellant SLBMs were distinguished by “wet launch”. However, this method has disadvantages. Filling the shafts with water takes time and creates acoustic noise. If a submarine is being pursued by an anti-submarine ship, it is able to quickly take direction and destroy it.

Solid propellant rockets are good because they can perform a “dry launch”. They are fired from a shaft with a powder charge, and the engine is turned on above the surface of the water. This method is quieter and faster, thanks to which the chances of a successful launch increase dramatically. Solid propellant missiles include the Soviet R-31 SLBM with a range of up to 4,200 kilometers and the R-39 (8,250 kilometers), as well as the newest R-30 Bulava (9,300 kilometers).

For "Dolphins" and "Boreys"

Today, Russian nuclear-powered ships use several types of ballistic missiles.

Firstly, these are liquid-fueled two-stage R-[illegible].s, which are armed with the last remaining boat of Project 667BDR Kalmar in service - the K-44 Ryazan. These missiles can throw three warheads of 200 kilotons each over a range of 6,500 kilometers.

Secondly, the R-29RM family of liquid-fuelled three-stage missiles remains in the Navy's arsenal. They are armed with six "strategists" of the 667BDRM "Dolphin" project - K-51 "Verkhoturye", K-84 "Ekaterinburg", K-114 "Tula", K-18 "Karelia", K-407 "Novomoskovsk" and the K -117 "Bryansk". Each boat has 16 mines.

The R-29RM was put into service more than 30 years ago and modernized several times. The latest modification, Sineva, flies 11,550 kilometers. Warhead - up to ten individual targeting units with a capacity of 100 kilotons each or four warheads of 500 kilotons with missile defense penetration equipment.

Finally, the most modern strategic nuclear-powered ships - three Project 955 Borey boats - K-535 Yuri Dolgoruky, K-550 Alexander Nevsky and K-551 Vladimir Monomakh - are armed with R-30 Bulava solid-fuel ballistic missiles. In addition, the heavy submarine cruiser Dmitry Donskoy, the last representative of Project 941, was converted into this SLBM. It carries 20 missiles, Borei - 16 each.The Bulava was put into operation in 2018 after almost 15 years of testing.

The Bulava delivers six individually targeted warheads of 150 kilotons each. The probable deviation coefficient does not exceed 350 meters.

24 August 2019, 13:44

A video of the Bulava launch from the Yuri Dolgoruky submarine has been published.
The advantages of the new SLBM include a short booster active section. It is believed that this is where missiles are most vulnerable to missile defense systems. In addition, the Bulava can maneuver during acceleration, which protects it from kinetic interceptors designed for conventional ballistic trajectories.

R-27 (ballistic missile) - Wikipedia

This term has other meanings, see R-27.
R-27 (URV Navy index - **4K10** , START code - **RSM-25** , according to the US and NATO classification - **SS-N-6 Mod 1, Serb**) - Soviet liquid-propellant single-stage ballistic missile of the D-5 complex, deployed on submarines (SLBMs) of project 667A and 667AU. The development of the rocket was carried out at SKB-385 under the leadership of chief designer V. Makeev. P. from 1962 to 1968. En service on March 13, 1968. Currently withdrawn from service. The last launch as part of combat

training was carried out in 1988. From 1991 to 1993, three launches of the Zyb launch vehicle, created on the basis of the R-27, were carried out.

Development history[edit]

The R-21 missile of the D-4 complex, adopted for service in 1963, with a firing range of 1400 km, was significantly inferior in basic characteristics to the American Polaris A1 (1960, 2200 km) and Polaris A2 (1962, 2800 km) missiles. To eliminate the backlog, the development of a new rocket was required.

On April 24, 1962, the USSR Council of Ministers issued Resolution No. 386-179 on the development of a new R-27 missile of the D-5 complex for arming Project 667A submarines. SKB-385 was appointed as the lead developer for the missile and the complex, the chief designer was V.P. Makeev. The development of the missile control system was entrusted to NII-592 (chief designer N.A. Semikhatov), and the placement of the complex on a Project 667A submarine was assigned to TsKB- 18 (chief designer Kovalev S. N.).

During the development of the rocket, a number of innovative solutions were used, which for a long time determined the appearance of the SKB-385 rockets:

These

measures made it possible to sharply increase the average density of the rocket layout, thereby reducing its dimensions, as well as to reduce the required volume of the shaft and annular gap tanks. Thus, compared to the R-21 missile, the firing range increased by 2 times, the length of the missile decreased by a third, the mass of the launcher decreased by more than 10 times, the mass of the rocket decreased by almost a third, and the volume of the annular gap decreased by almost 5 times. The load on the boat per missile (the mass of missiles, launchers, missile silos and annular gap tanks) has decreased by three times. [2]

Scheme of the R-27 rocket

1 - monoblock warhead; 2 — instrument compartment; 3 — rubber-metal shock absorbers; 4 — system

for overflowing the oxidizer from the lower forecastle to the upper one; 5 — pipes of the tank pressurization system; 6 — upper and lower oxidizer forecastles; 7 — oxidizer intake system; 8 — fuel tank; 9 — propulsion engine block; 10 — steering block

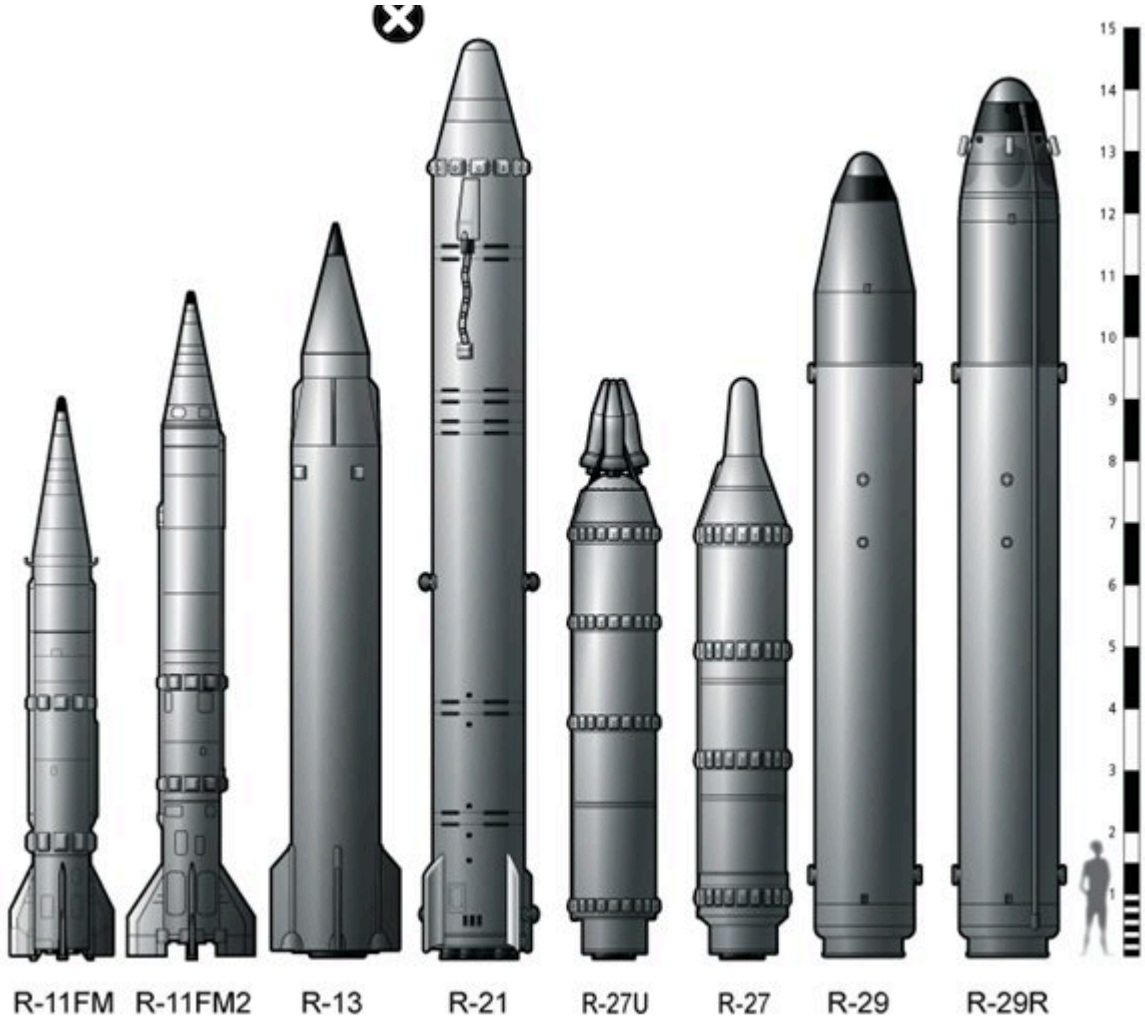
The R-27 missile was made according to a single-stage design with a monoblock detachable warhead.

The rocket body was all-welded, sealed, and made of "wafer" sheets obtained by chemical milling of plates from the aluminum-magnesium alloy AMg6. A 5-6-fold increase in the thickness of the original metal sheet over the thickness of the resulting shell was achieved. Subsequently, when using mechanical milling, this figure was increased to 9. [3] The outer surface of the body was protected by a heat- and moisture-resistant coating based on asbestos textolite. [4]

The rocket was equipped with a 4D10 liquid-propellant rocket engine developed by OKB-2 (chief designer A.M. Isaev) [3] , which consisted of two blocks. The engine consisted of a propulsion block with a thrust of 23 tons [5] and a steering block of two chambers with a total thrust of 3 tons [6] . The liquid rocket engine used self-igniting fuel components. Unsymmetrical dimethylhydrazine (UDMH) was used as a fuel, and nitrogen tetroxide (AT) was used as an oxidizer. [7] The supply of fuel components was carried out by turbopump units.The main engine operated according to a scheme with afterburning of oxidizing gas. The engine thrust was regulated by a fuel flow regulator. The steering unit was made according to a scheme without afterburning, with a gas generator producing gas with an excess of fuel. The steering block's thrust was controlled by a regulator on the common oxidizer line. [8]

For the first time in world practice, the engine was placed in the fuel tank - the so-called "recessed design. When installing the engine, only permanent connections were used - welding and soldering.

The engine became



maintenance-free and untestable. The engine was started from one squib, and the entry into mode was controlled by its own automation. [3] The steering engine's oscillating chambers were installed on the conical bottom of the fuel tank [3] , at an angle of 45° to the rocket stabilization planes [6] . The steel elements of the engine were fastened to the aluminum body using special bimetallic adapters. [9]

To reduce the cavities of the rocket that were not filled with fuel, a common two-layer bottom of the fuel and oxidizer tanks was used.This made it possible to eliminate the intertank compartment. Another innovative solution was factory refueling with subsequent “ampulization” of the tanks by welding the filling and drain valves. [10] Together with work to increase the corrosion resistance of materials, the tightness of seams and joints, this made it possible to set the service life of the missiles in a fueled state to 5 years. And subsequently bring it to 15 [10]

For the first time in the USSR, elements of the inertial control system (for SLBMs [6]) were placed on a gyro-stabilized platform. The control system equipment was located in a sealed volume formed by the hemispherical upper bottom of the oxidizer tank. This made it possible to exclude the classic instrument compartment from the rocket design. [4]

The rocket was equipped with a monoblock detachable warhead weighing 650 kg. [11] [12] The po the nuclear charge placed on it is 1 Mt. [11] [12] To separate the warhead from the rocket, for the first time

in the practice of the GRC, an explosive dev was used - a detonating elongated shaped charge based on a high explosive. [13] When firing at the maximum range, a COE of 1.9 km was achieved. [14]

The type of rocket launch is wet, from a pre-flooded shaft. A special adapter was installed at the bottom of the R-27, with the help of which the rocket was docked with the launch pad. In the process of preparing the rocket for launch, the rocket tanks were pressurized. Water entered the mine and the pressure was equalized with the outboard pressure. The cover of the missile silo was opening. To reduce the hydraulic shock that occurs when starting an engine in a silo filled with a rocket, the engine was started in a sealed volume formed by an adapter and a launch pad. A technology for creating a “dynamic bell” was developed. At the beginning of the launch, the steering motors were started in the “gas bell” formed by the adapter. Then, when the rocket began to move, the propulsion engine was started and gradually brought to full thrust mode.

As the rocket moved further, the moment from the oncoming flow of water began to act on it.The reduction of the loads acting on the structure of the rocket emerging from the silo was facilitated by the pre-pressurization of the tanks and the belts of special rubber-metal shock absorbers located on the rocket itself.

Maintenance and procedures for pre-launch preparation and launch of missiles were automated as much as possible. From a single console of the ship's system for daily and pre-launch maintenance of missiles, remote control and monitoring of the status of the systems was provided. The missile weapons control panel was used to carry out complex routine checks and control pre-launch preparations and missile launches. [5]

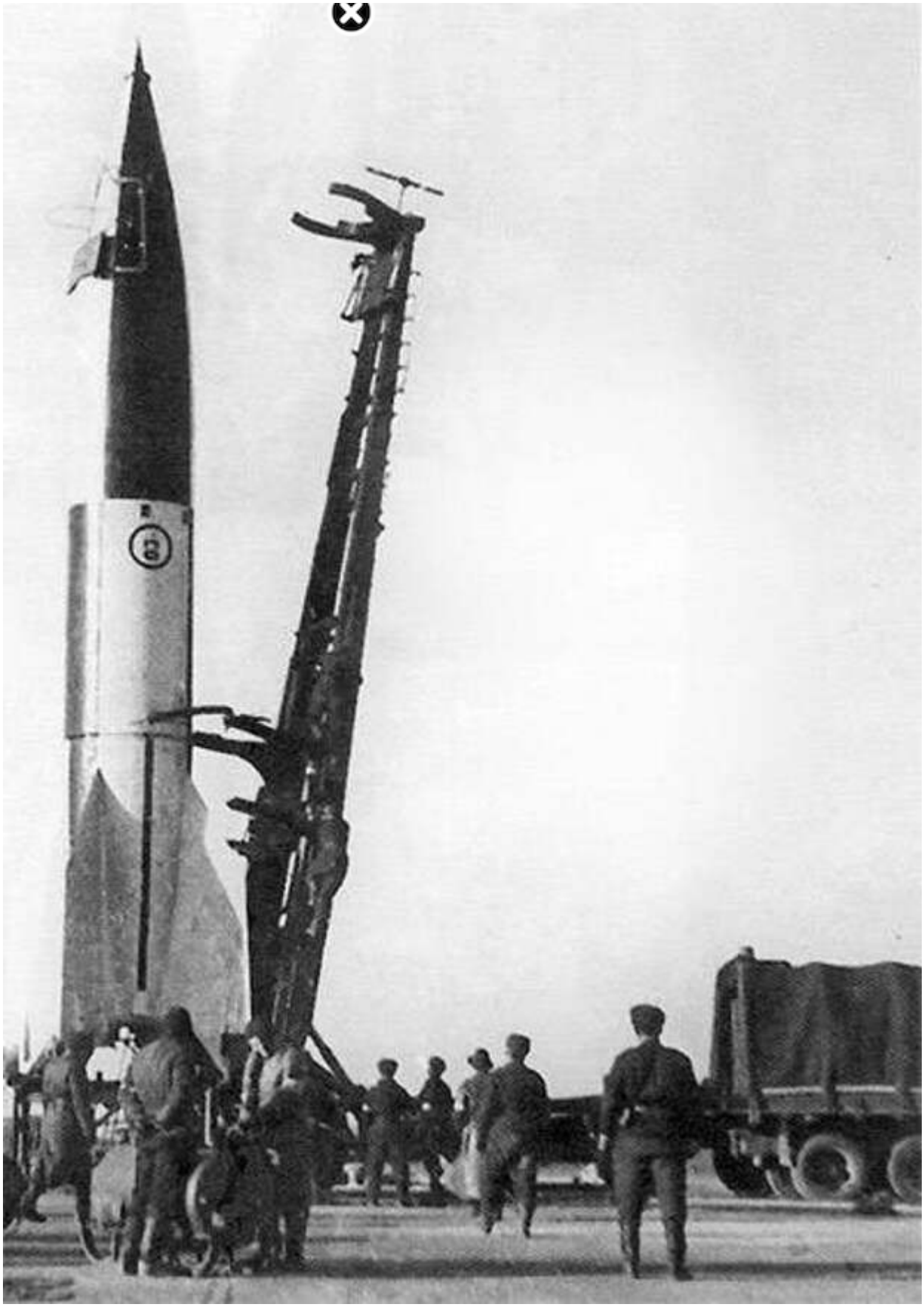
The initial data for firing was generated by the “Tucha” combat information and control system created under the leadership of chief designer R. R. Belsky. The equipment allowed live firing of two eight-missile salvoes. [5]

The missiles were launched from a depth of 40-50 m, the boat speed was up to 4 knots and the sea state was 5 points. [15] Pre-launch preparation time for rockets is 10 minutes. The firing interval of missiles in one salvo is 8 seconds. [5] The time between salvos is not specified by sources.

Testing of the D-5 complex was carried out in three stages. The first stage of throwing tests of full-scale prototypes of the R-27 was carried out from the PSD-5 floodable floating test bench in September 1965. Two launches were carried out. [5] [16]

In January 1967, testing of missile prototypes began in the Black Sea from the Project 613D5 submarine (an experimental Project 613D7 submarine converted at Plant No. 444 in Sevastopol [5]) in a sub d position. The delay in work was due to the fact that the customer received the boat only on December

23, 1965. On January 18, 1967, the first launch of a



prototype 4K10 rocket was carried out from a depth of 45 m at a boat speed of 3 knots, a sea state of 3 points and a wind speed of 7-8 points. The last, sixth test was carried out on August 10, 1967. [5]

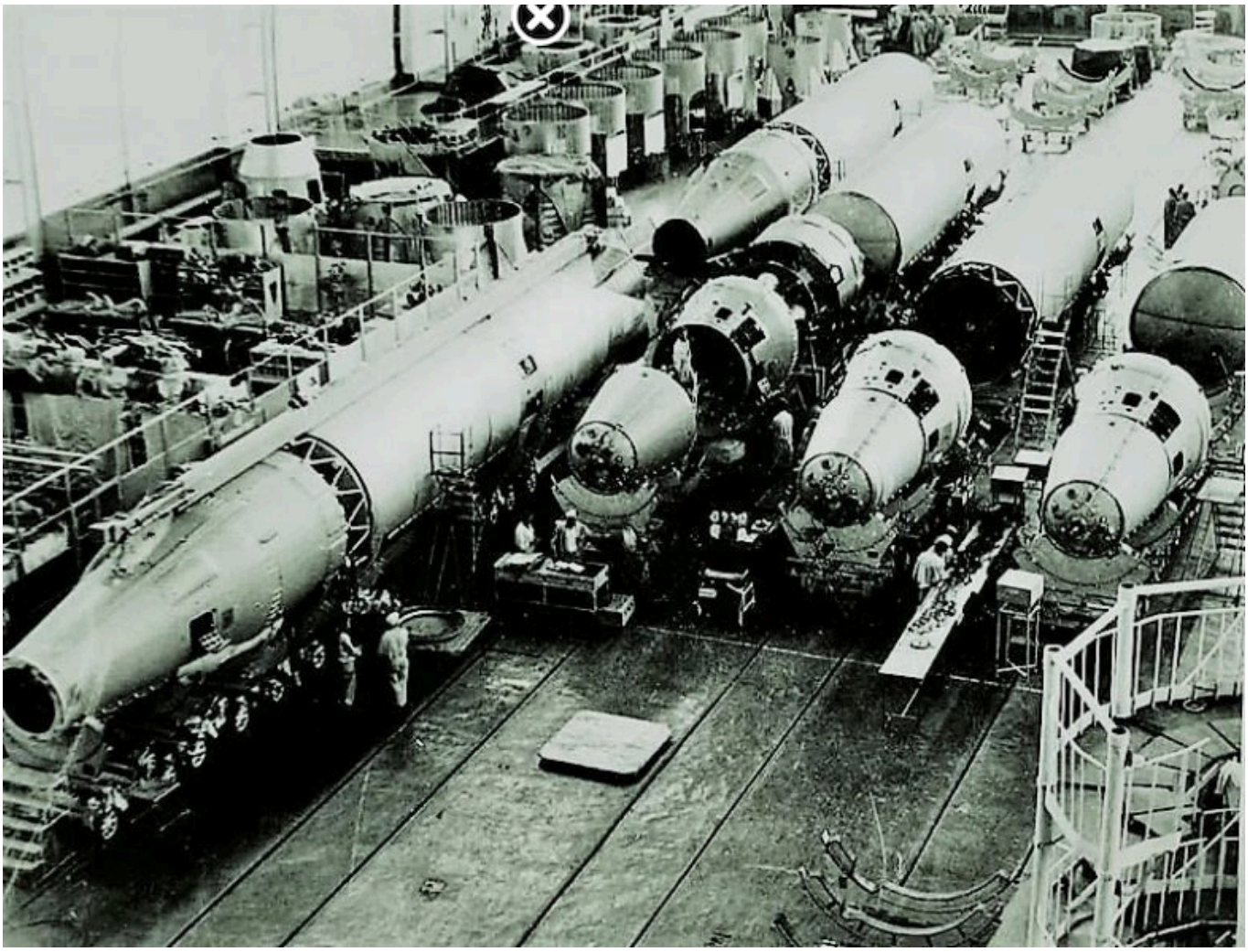
The second stage was carried out in parallel.Flight tests from a ground stand at the Kapustin Yar test site [17] were carried out from June 1966 to April 1967. A total of 17 launches were carried out, of w 12 were considered successful. [14]

Full-scale joint flight tests of the R-27 began in the Northern Fleet on the lead boat of Project 667A, the K-137 Leninets, in August 1967. A total of 6 launches were carried out. [14]

The D-5 complex with the R-27 missile was adopted for service on March 13, 1968 by Decree of the USSR Council of Ministers No. 162-164. [5]

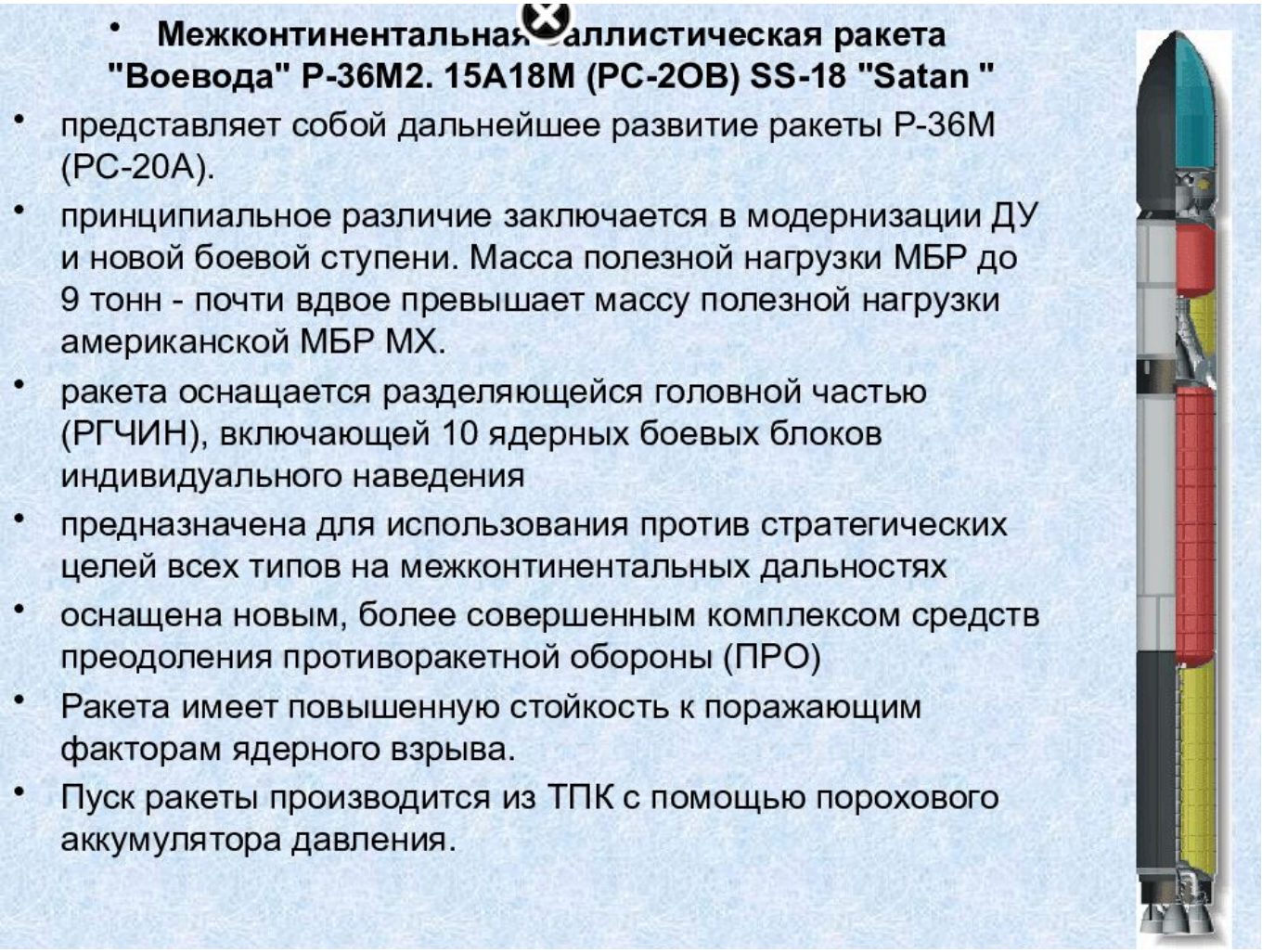
R-27U[edit]

The resolution of the Council of Ministers on the modernization of the D-5 complex was issued on June 10, 1971. [18] The goal was to create two versions of the modernized missile. The first option provided for equipping the missile with a warhead with three warheads, while maintaining the maximum firing range. The head part is of the “scattering” type, with blocks without individual guidance. The second option provided for increasing the range and increasing the accuracy of the missile.The modernized version of the complex was designated D-5U, and the missiles - R-27U. A missile was created with three warheads with a capacity of 200 kt each with a maximum range of 2400 km. The multiple warhead was of the so-called “scattering type” - the warheads did not have individual guidance. At the end of the active section, the blocks were “pushed” in different directions at low speed. According to the second option, a missile with a range of 3000 km and a monoblock warhead with a power of 1 Mt was created. A CEP of 1.3 km was achieved. [14] The modernizatio



affected the engine (thrust was increased) and the control system. In the west, the missiles were designated SS-N-6 Mod 3 and Mod 2, respectively.

Ship tests of R-27U missiles took place from September 1972 to August 1973. [12] 16 launches were carried out, all considered successful. The R-27U missile was adopted for service on January 4, 1974 by resolution of the Council of Ministers No. 8-5. [18] The D-5U complex with R-27U missiles was equipped with Project 667AU nuclear-powered missile submarines under construction, as well as Project 667A boats after modernization. [14]



R-27K[edit]

The initial resolution of the Council of Ministers of April 24, 1962 on the creation of the D-5 complex also provided for the creation of a missile with a homing warhead capable of hitting moving ships. The anti-ship version of the missile was designated R-27K (GRAU index 4K18). In the west, the missile received the designation SS-NX-13. The rocket was equipped with a second stage with a liquid rocket engine developed by KB-2 (chief designer A. M. Isaev). To maintain the dimensions of the missile, the dimensions of the first stage were reduced, which ultimately led to a reduction in the maximum firing range to 900 km. The warhead is monoblock, nuclear, with a capacity of 0.65 Mt. [19]

Guidance in the passive area was carried out using a passive radar seeker, with signal processing by an on-board digital computer system. [20] The initial data for firing was provided by the Legend satellite system or the Success-U aviation system. Data processing on the ship's Kasatka reconnaissance equipment made it possible to determine the coordinates of a group of ships with an accuracy of up to 25 km.This data is constantly becoming outdated - during pre-launch preparation, the target's location can change up to 150 km. [21] Therefore, control was provided for the second stage by turning on the second stage propulsion system twice during the extra-atmospheric flight phase. Initially, the option of additional correction of the trajectory in the atmospheric section and equipping the rocket with

power warhead was also considered. But later this option was abandoned in favor of a purely ballistic one, with a high-power warhead. [22]

Testing of the missile system began in December 1970. [7]

The ground test cycle at the Kapustin Yar test site included 20 launches (of which 16 were considered successful). [22] The submarine “K-102” of Project 629, with 4 missile silos on board, was converted to carry Project 605 missiles. The first launch from a submarine was carried out in December 1972. And in November 1973, the tests ended with a two-missile salvo.A total of 11 launches were carried out, of which 10 were considered successful. During the last launch, the target ship was hit by a direct hit from a guided unit. [22]

Launch vehicle "Zyb"[edit]

In the 1990s, work was carried out to create launch vehicles based on submarine-launched ballistic missiles. The Zyb launch vehicle was created on the basis of the R-27. The rockets were used in research experiments requiring microgravity. The period of weightlessness is from 17 to 24 minutes. The Zyb can launch a payload with a volume of 1.5 m³ onto a suborbital trajectory. Payload mass is 650 kg at a maximum orbital altitude of 1800 km, or 1000 kg at an orbital altitude of 1000 km. [23]

Three launches were carried out. On December 1, 1991 [23], the “Sprint” module was launched, developed by the State Research Center together with the NPO Composite. The module was intended for testing technologies for producing superconducting materials and carried 15 exothermic furnaces on board. [24]

On December 9, 1992 and December 1, 1993 [23], the Ether module was launched with the Medusa biotechnological equipment weighing 80 kg. The module, developed jointly with the Center for Space Biotechnology, was intended for research into the technology of purifying biological and medical preparations using electrophoresis under zero-gravity conditions [24] .

In total, about 1,800 missiles were produced. The D-5 complex was operated from 1968 to 1988. A total of 492 missile launches were carried out, of which 429 were considered successful. The maximum number of launches was in 1971 - 58. This is a kind of record for Soviet and Russian ballistic missiles from submarines. The complex also holds the record for the average annual number of launches - 23.4.

During operation of the D-5U complex, 161 launches were carried out, of which 150 were successful. The last launches of R-27 and R-27U missiles according to combat training plans were carried out in 1988. [14] After this, launches were carried out only for research purposes.During operation, 8 missiles were fired in one salvo twice (once each in the Northern and Pacific fleets). All launches were considered successful. Over the entire period of operation, more than 10 thousand missiles were loaded and unloaded; boats armed with RSM-25 carried out 590 combat patrols in various areas of the World Ocean.

During operation, several accidents occurred with the destruction of missiles. Five people were killed and one submarine, K-219, was lost.

During loading with a violation of the loading and unloading process, the rocket fell from a height of 10 m onto the pier. The oxidizer tank was destroyed. Two people from the loading party died from exposure to oxidizer vapors on unprotected respiratory organs. [25]

A rocket was destroyed three times in the silo of a boat on combat duty.

During the Ocean-76 exercise, three missiles were pre-launched on the K-444 boat. Two missiles were launched, but the third missile was not fired. Due to a series of human errors, the pressure in the rocket tanks was released before the boat surfaced.The seawater pressure destroyed the rocket tanks, and during the ascent and draining of the mine, the oxidizer leaked into the mine. Thanks to the skillful actions of the personnel, the emergency situation did not develop. [25]

In 1973, on the K-219 boat located at a depth of 100 m, due to a false operation of the irrigation system when the mine drainage valve and the manual valve on the jumper between the main drainage line of the boat and the mine drainage pipeline were open, a communication between the missile silo and sea water occurred. The pressure of 10 atmospheres destroyed the rocket tanks. While draining the mine, rocket fuel ignited, but the timely operation of the automatic irrigation system prevented further development of the accident. The boat returned safely to base. [25]

Fire on K-219 in October 1986

The third incident also occurred on the K-219 boat on October 3, 1986. For unknown reasons, during the dive after a communication session, water began to flow into the missile silo. The crew tried to turn off the automation and drain the water using non-standard means.As a result, the pressure first became

equal to the outboard pressure and the rock[illegible]anks collapsed. Then, after draining the mine, fuel components ignited. The automatic irrigation system that was turned off did not work and an explosion occurred. The cover of the missile silo was torn off, and a fire started in the fourth missile compartment. It was not possible to put out the fire on our own. The personnel left the boat, the compartments filled with sea water and the boat sank. During the fire and smoke in the 4th and 5th missile compartments, 3 people were killed, including the commander of the warhead-2. [25]

The operating experience of RSM-25 missiles was analyzed and taken into account when developing new complexes. As a result, there was not a single loss of life during the operation of subsequent missiles.

Removal from service[edit]

The R-27U modification was withdrawn from service even before the collapse of the Soviet Union, in 1989. [19] Other modifications of the missile were removed from service in Russia as part of the implementation of the START-1 treaty. According to the September 1990 memorandum, 192 nuclear warheads were deployed on the R-27 on the territory of the USSR.As of July 1997, Ukraine, Belarus and Kazakhstan, according to the Lisbon Protocol [26], renounced nuclear weapons, and Russia had 16 deployed warheads on the R-27. [27] A January 2008 memorandum confirmed that all R-27s in Russia had been withdrawn from service. [28]

Performance characteristics[edit]

	R-27	**R-27U**		**R-27K**
Rocket type	SLBM			RCC
GRAU index	4K10 [11]			4Q18 [20]
START code	RSM-25	RSM-25		
NATO code	SS-N-6 Mod 1 "Serb"	SS-N-6 Mod 2 "Serb"	SS-N-6 Mod 3 "Serb"	SS-NX-13
Complex	D-5	D-5U		
Carrier (submarine)	project 667A	project 667AU		project 605
Number of launchers	16	16		4
Rocket data				
Number of steps	1	1	1	2

Engine	Liquid rocket engine 4D10	LRE		
Weight and dimensions				
Rocket mass, kg	14 200	14 200	14,200?	13,250 [20]
Length, mm	8890	8890	8890	~9000 [20]
Diameter, mm	1500			
Payload				
Head mass, kg	650	650	3×170 kg [29]	?
Head type	monoblock		MIRV RT	Homing warhead
Nuclear power	1 Mt (0.6—1.2 Mt [12] [30])	1 Mt (0.6—1.2 Mt [12] [30])	3×0.2 Mt (3×0.1—0.8 Mt [12] [30])	
KVO, km	1.9 (1.1 [12] [30])	1.3—1.8		
Trajectory parameters				
Speed at the end of the active section, m/s	4400 [20]			
Height at the end of the active section, km	120 [20]			
Active section time, s	128.5 [20]			
Maximum altitude, km	620 [20]			
Maximum range, km	2500 [20] (2400 [12] [30])	3000 (3200 [12] [30])	2500 (3200 [12] [30])	900 [20]
Speed of encounter with target, m/s	300 [20]			
Story				
Developer	SKB-385 (GRC named after.Makeeva)			

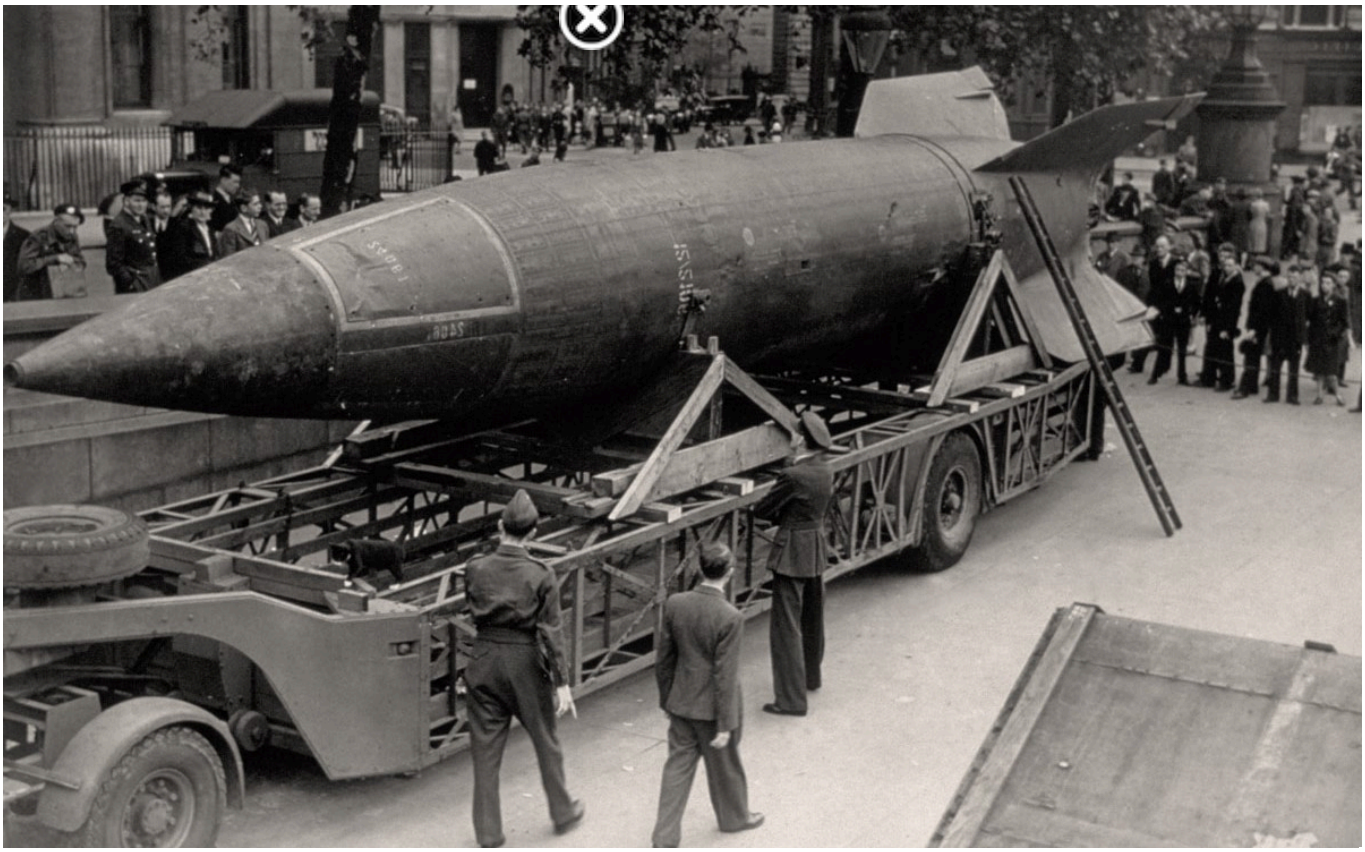
			
Constructor	Makeev V. P.		
Start of development	April 24, 1962	June 10, 1971	
Launches from the stand	September 1965 - August 1967	were not carried out	
Launches from a submarine	December 1972 - November 1973	September 1972 - August 1973	
Adoption	March 13, 1968	January 4, 1974	was not accepted
Manufacturer	Zlatoust Machine-Building Plant Krasnoyarsk Machine-Building Plant		

Project evaluation[edit]

The D-4 missile system with the R-27 missile for arming Project 667A submarines was a response to the American Polaris program. [31] In terms of its tactical and technical characteristics, the R-27 missile became an analogue of the Polaris A1 missile, and the monoblock version of the R-27U missile became an analogue of the Polaris A2.The version of the R-27U missile with three warheads was already significantly inferior to its Polaris A3 counterpart in range. At the same time, Soviet missiles were put into service 8-10 years later and had worse accuracy indicators (CAO). [32] In 1970, the United States adopted the Poseidon C3 multiple warhead missile with ten individually targeted units, allowing it to dramatically increase the effectiveness of its naval strategic nuclear forces.

A distinctive feature of Soviet missiles was that they used rocket engines with liquid fuel and were single-stage, while American missiles were created with solid fuel engines and were two-stage. Soviet missiles were slightly lighter, but at the same time had larger dimensions. The fire and explosion hazard was also higher than that of American missiles.

French rocket scientists chose the American path and created their first rockets - M1/M2 and M20 - two-stage with solid propellant engines.In terms of their tactical and technical characteristics, t



missiles corresponded to the monoblock versions of the R-27 and R-27U missiles, had comparable accuracy and were put into service several years later than the R-27.

The short range of Soviet missiles necessitated combat patrols of Soviet SSBNs in the areas of operation of powerful anti-submarine defense forces of the US Navy and NATO, which reduced the combat stability of Soviet missile carriers [31] . Despite a number of shortcomings, the USSR managed to create a fairly effective strategic missile system. A number of new technical solutions were tested on the R-27 rocket. The use of these developments on missile systems with R-29 and R-29R missiles subsequently made it possible to bridge the gap with the United States.

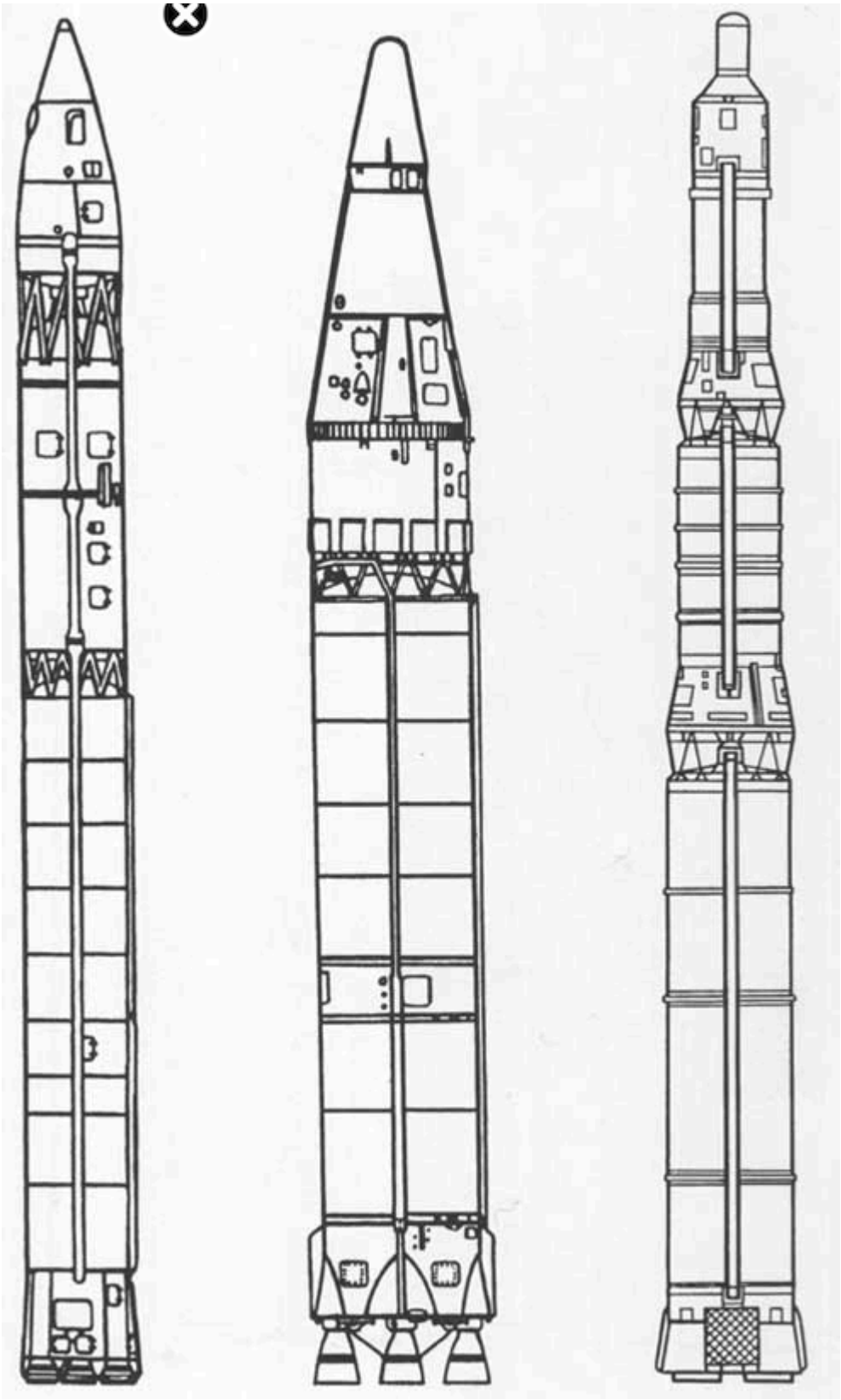
TTX	Polaris A1	Polaris A2	Polaris A3	R-27	R-27U		Poseidon C3	R-29	M1	M
A country										
Year of adoption	1960	1962	1964	1968	1974		1970	1974	1972	19
Maximum range, km	2200	2800	4600	2500	3000	2500	4600	7800	3000	32
Throwing weight, kg	500	500	760	650	650	>650	2000	1100	1360	10

Head type	monoblock		MIRV RT	monoblock		MIRV RT	MIRV IN	monoblock		
Power, kt	600	800	3×200	1000	1000	3×200	10×50	1000	500	12(
KVO, m	1800		1000	1900	1300—1800		800	1500		10(
Launch weight, t	12.7	13.6	16.2	14.2			29.5	33.3	20	
Length, m	8.53	9.45	9.86	9.65			10.36	13	10.67	
Diameter, m	1.37			1.5			1.88	1.8	1.49	
Number of steps	2			1			2	2	2	
engine's type	Solid propellant rocket engine			LRE			Solid propellant rocket engine	LRE	Solid propellant rocket engine	

1. ↑ SKB-385.Decree. op. — P. 88.
2. ↑ SKB-385. Decree. op. — P. 88-89.
3. ↑ [3.0] [3.1] [3.2] [3.3] SKB-385. Decree. op. — P. 87.
4. ↑ [4.0] [4.1] Shirokorad, 2003, p. 515
5. ↑ [5.0] [5.1] [5.2] [5.3] [5.4] [5.5] [5.6] [5.7] Shirokorad, 2003, p. 516
6. ↑ [6.0] [6.1] [6.2] Strategic nuclear weapons of Russia. Decree. op. — P. 276.
7. ↑ [7.0] [7.1] Yu. L. Korshunov, E. M. Kutovoy. Ballistic missiles of the domestic fleet. - St. Petersburg: Gangut, 2002. - 19-20 p. - (Gangut Library). — 1200 copies. — ISBN 5-85875-043-5.
8. ↑ N. I. Leontyev, P. M. Mitin. Improving the energy and mass characteristics of propulsion systems and liquid rocket engines for submarine ballistic missiles. Retrieved November 22, 2009. Archived from the original on January 26, 2012.
9. ↑ SKB-385.Decree. op. — P. 86.
10. ↑ [10.0] [10.1] SKB-385. Decree. op. — P. 89.
11. ↑ [11.0] [11.1] [11.2] Strategic nuclear weapons of Russia. Decree. op. — P. 277.
12. ↑ [12.0] [12.1] [12.2] [12.3] [12.4] [12.5] [12.6] [12.7] [12.8] [12.9] R-27 / SS-N-6 SERB (English). Federation of American Scientists (FAS). Retrieved January 12, 2010. Archived from the original on January 29, 2012.

13. ↑ Kanbikov M. Sh., Lyakishev B. M., Teli[illegible] Yu. S., Shikhov V. B. Some design features of submarine ballistic missiles. — To the 50th anniversary of the State Missile Center “KB named after. Academician V.P. Makeev." Retrieved December 6, 2009. Archived from the original on January 29, 2012.
14. ↑ [14.0] [14.1] [14.2] [14.3] [14.4] [14.5] Strategic nuclear weapons of Russia.Decree. op. — P. 278.
15. ↑ Shirokorad, 2003, p. 516-518
16. ↑ Discrepancy. According to the reference book “Strategic Nuclear Weapons of Russia,” page 278, 6 launches were carried out from a floating stand.
17. ↑ Alexander Tikhonov. Test site near the Volga. Red Star (January 14, 2009). Retrieved December 6, 2009.
18. ↑ [18.0] [18.1] Shirokorad, 2003, p. 518
19. ↑ [19.0] [19.1] Andrian Nikolaev. Submarine ballistic missile (SLBM) missile systems. Military parity. Retrieved December 6, 2009. Archived from the original on January 29, 2012.
20. ↑ [20.00] [20.01] [20.02] [20.03] [20.04] [20.05] [20.06] [20.07] [20.08] [20.09] [20.10] A. B. Shirokorad. Encyclopedia of domestic missile weapons. Decree. op. — P. 517.
21. ↑ SKB-385. Decree. op. — P. 101.
22. ↑ [22.0] [22.1] [22.2] SKB-385.Decree. op. — P. 102.

23. ↑ [23.0] [23.1] [23.2] R-27 (English). Encyclopedia Astronautica. — Description of the R-27 missile. Retrieved December 6, 2009. Archived from the original on January 29, 2012.
24. ↑ [24.0] [24.1] SKB-385. Decree. op. — P. 346.
25. ↑ [25.0] [25.1] [25.2] [25.3] L. N. Rolin, Yu. G. Rudenko. Experience in operating a naval missile system with the RSM-25 missile. Retrieved December 6, 2009-12-06. Archived from the original on January 29, 2012.
26. ↑ Protocol to the Treaty on the Reduction and Limitation of Strategic Offensive Arms. The Arms Control Association (ACA). Retrieved January 12, 2010. Archived from the original on January 29, 2012.
27. ↑ US and Soviet/Russian Strategic Forces (English). The Arms Control Association (ACA). Retr[illegible] January 12, 2010. Archived from the original on January 29, 2012.



28. ↑ START Anew: The Future of the Strategic Arms Reduction Treaty (English). The Arms Control Association (ACA). Retrieved January 12, 2010. Archived from the original on January 29, 2012.
29. ↑ Warhead for the first multiple warhead of a sea-based ballistic missile. Museum of the RFNC-VNIITF, Snezhinsk. . Retrieved August 16, 2011. Archived from the original on August 18, 2011.
30. ↑ 30.0 30.1 30.2 30.3 30.4 30.5 30.6 According to Western sources.
31. ↑ 31.0 31.1 Yu. V. Vedernikov. Chapter 2. Comparative analysis of the creation and development of the Naval Strategic Nuclear Forces of the USSR and the USA // Comparative analysis of the creation and development of the Naval Strategic Nuclear Forces of the USSR and the USA.
32. ↑ 2.2. The main stages of development of maritime strategic complexes. 2003, “Red October”, Saransk. Retrieved December 19, 2009. Archived from the original on January 29, 2011.

- SKB-385, Mechanical Engineering Design Bureau, State Research Center “Design Bureau named after. Academician V.P. Makeev” / Comp. Kanin R. N., Tikhonov N. N.; under general ed. V. G. I[illegible]r.

— M.: State Rocket Center “KB named after. Academician V.P. Makeev"; Military parade, 2007. - 408 p. — ISBN 5-902975-10-7.

- Strategic nuclear weapons of Russia / Ed. P.L. Podviga. - M.: Publishing House, 1998. - ISBN 5866560798.
- Shirokorad A. B. Encyclopedia of domestic missile weapons 1918-2002 / Under the general editorship. A.E. Taras. - M.: Harvest, 2003. - 544 p. — (Library of Military History). — 5100 copies. — ISBN 985-13-0949-4.

A liquid-propellant rocket will be created for new strategic boats

The Russian General Staff has decided on how to develop the Strategic Nuclear Forces (SNF). This follows from the statements of First Deputy Defense Minister Valery Gerasimov at a briefing on Monday evening for foreign attaches and the presentation he showed.For the Strategic Missile Forces (Strategic Missile Forces), the key task is to place the RS-24 Yars and Avangard complexes on combat duty, as well as to develop the heavy silo-based intercontinental ballistic missile (ICBM) Sarmat; in the aviation part of the strategic nuclear forces - the modernization of Tu-160 and Tu-95MS bombers, the resumption of production of the Tu-160 in the M2 modification, the creation of a stealth bomber and a promising long-range cruise missile; in the naval sector - the construction of Project 955A strategic missile carriers and the development of a new ballistic missile for submarines (SLBM). The rearmament of strategic nuclear forces is carried out in accordance with the provisions of the T on the Limitation of Strategic Offensive Arms (START-3), the fate of which after 2021 remains uncertain

due to the lack of a clear position of the Un[illegible] States, Gerasimov emphasized. The development of strategic nuclear forces was a priority in the previous state weapons program for 2011–2020, says a Vedomosti source close to the Ministry of Defense: no less attention will be paid to it in the program until 2027.

Project 955A new generation missile carriers (pictured) are armed with solid fuel Bulava /TASS

The projects announced by the Chief of the General Staff are at various stages of implementation. For example, the first regiment of the Avangard complex (consisting of the UR-100UTTH ICBM with the 15YU71 hypersonic glide winged warhead) is already being deployed in the 13th missile division of the Strategic Missile Forces in the Orenburg region; only the first two launches are planned for 2020 on the Sarmat theme , and the first of 10 Tu-160 ordered in 2018 in a new look will be delivered to the customer in 2021, says a person in the ministry. Deputy Defense Minister Alexei Krivoruchko told the Russian Defense publication on Wednesday that by 2027 the military expects to begin delivering a promising long-range aviation complex to the troops. These plans are still in place, confirms the manager of an aviation industry enterprise, but purchases will not be of a massive nature.

Soviet-built boats 667 BDM (pictured) carry liquid “Sineva” /TASS

176 units

Russia could deploy ballistic missiles for submarines in 2017.under the terms of the START-3 treaty

There are plans to update the naval component of the strategic nuclear forces, says Vedomosti’s interlocutor close to the department: by 2027, 10 strategic Boreys should enter service. The new [illegible] mentioned in the presentation implies development at the State Missile Center named after. Makeev

(Miass) of a new rocket with a liquid engine, the corresponding development work has already been opened, he clarifies. An expert in the field of strategic weapons, Pavel Podvig, believes that we can talk about continuing work on the R-29RMU-2 Sineva missile, which is mass-produced at Krasmash in Krasnoyarsk for Project 667 BDRM submarines - the new Project 955A submarines are now equipped with solid-fuel SLBMs “ Mace". Proponents of liquid-propellant rockets have their own arguments, which include increased efficiency and an increased number of warheads, but in this case the situation is more like providing support to industry, he believes.

Submarine ballistic missile R-27 (4K10, RSM-25)

The results obtained during the development of domestic first-generation ballistic missile submarines (SLBMs) (R-11FM, R-13 and R-21) and their comparison with American achievements in this area (Polaris A1, Polaris A2) led to the formulation of the question of the need for a qualitative leap in the development of naval strategic forces.The main directions of their development were clear: a manifold increase in the ammunition load of missiles on a submarine; reducing the size of missiles, warheads, launchers (missile launch systems) and missile silos; automation of missile maintenance processes during storage, pre-launch preparation and salvo firing; everyone to improve the tactical and technical characteristics and operational quality of missiles and missile systems, etc. The purpose of developing new complexes was to ensure the development of the second component of the country's strate missile forces - naval strategic nuclear forces. To achieve this goal, significant progress was needed in

domestic naval rocketry. The R-21 missile complex D-4, adopted by the Russian Navy in 1963, with a firing range of 1400 km, was inferior in basic characteristics to the American missiles Polaris A1 (1960, 2200 km) and Polaris A2 (1962, 2800 km). In addition, as noted above, the number of SLBMs on a typical Soviet missile submarine significantly exceeded the number of SLBMs on a typical Soviet missile submarine - 16 versus 3.A new missile submarine requires the development of both a new missile and a new nuclear submarine.

On April 24, 1962, Resolution No. 386-179 of the Council of Ministers of the USSR was issued on the development of a new R-27 missile of the D-5 complex for arming new nuclear missile submarines of Project 667A. SKB-385 was appointed as the lead developer for the rocket and complex, and V.P. Makeev was appointed as the chief designer. The development of the missile control system was entrusted to NII-592 (chief designer N. A. Semikhatov), and placement of the complex on a Project 667A submarine - TsKB-18 (chief designer S. N. Kovalev).

Testing of the D-5 complex was carried out in three stages. The first stage of throwing tests of full-scale prototypes of the R-27 was carried out from the PSD-5 floodable floating test bench in September 1965. Two launches were carried out. In January 1967, testing of missile models began in the Black Sea from the Project 613D5 submarine (an experimental Project 613D7 submarine converted at Plant No. 444 in Sevastopol) in an underwater position.The delay in work was due to the fact that the customer

received the boat only on December 23, 1965. On January 18, 1967, the first launch of the 4K10 prototype

was carried out from a depth of 45 m with [illegible]oat at 3 knots, sea state 3 and wind speed 7-8. The last, sixth test was carried out on August 10, 1967. The second stage was carried out in parallel. Flight tests from a ground stand at the Kapustin Yar test site were carried out from June 1966 to April 1967. A total of 17 launches were carried out, of which 12 were considered successful. Full-scale joint flight tests of the R-27 began in the Northern Fleet on the lead boat of Project 667A, the K-137 Leninets, in August 1967. A total of 6 launches were carried out. The D-5 company with the R-27 missile was put into service on March 13, 1968 by Decree of the Council of Ministers of the USSR No. 162-164, starting with Project 667A, all domestic nuclear missile submarines of new projects were designated “strategic nuclear missile submarine” . Compared to previous SLBM systems for the Navy, the D-5 complex represented a giant leap forward.As part of the Red Named Northern Fleet, the first fleet to receive new ships, Project 667A SSBNs entered the 19th and 31st divisions.

At the same time, compared to SLBMs. Poseidon S3 (1971, 4600 km, the world's first SLBM with MIRV, 10 BB). In 1968, naval strategic nuclear forces appeared in Great Britain, the second most powerful NATO country: SLBMs SLBMs Polaris A3T version (Polaris A3 with increased resistance to PFNV) entered service. In 1971, France also had its own M1 SLBMs (2600 km). striving to pursue a nuclear policy independent of the United States.

Under these conditions, on June 10, 1971, a Resolution of the USSR Council of Ministers was adopted on the modernization of the D-5 complex. The goal was to create two versions of the modernized rocket. The first option involves equipping the missile with a warhead with three warheads, with the maximum firing range of the previous option and improving accuracy characteristics. The second option was intended to increase the firing range while simultaneously increasing accuracy.According to the second option, a missile with a range of 3000 km and a lightweight monoblock thermonuclear head power of 1 Mt was created. The upgraded version was designated D-5U, and the missiles were designated R-27U.

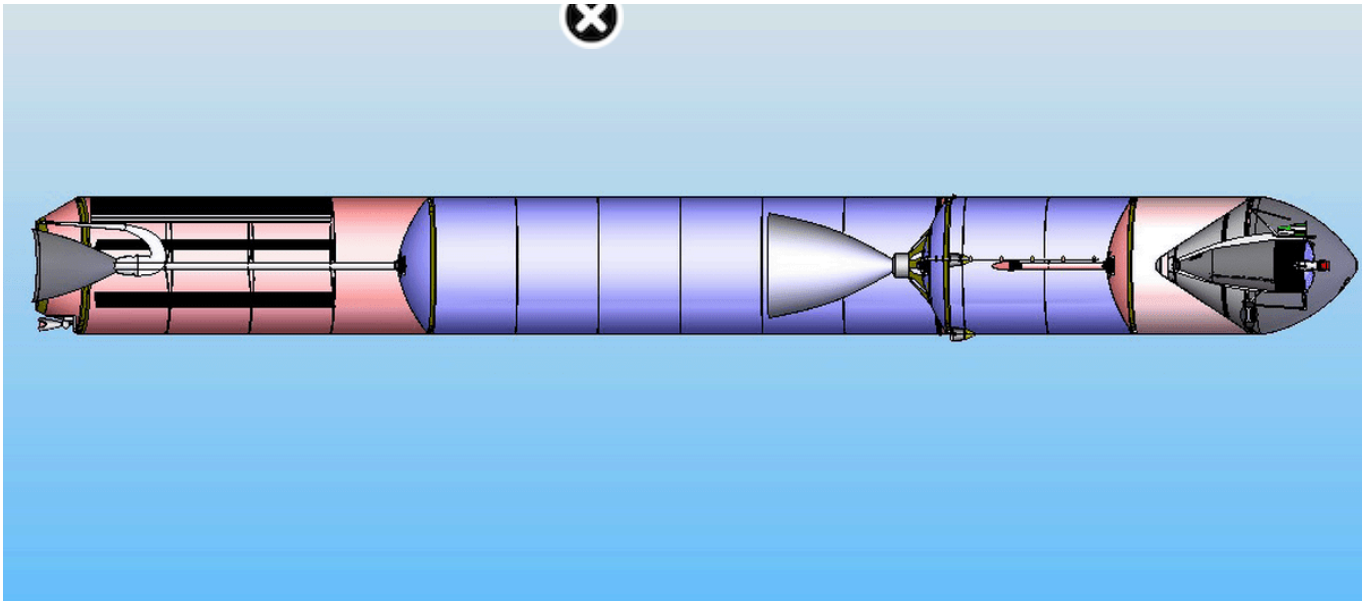
Ship tests of R-27U missiles took place from September 1972 to August 1973. 16 launches were carried out, all considered successful. The R-27U missile was put into service on January 4, 1974 by Resolution of the Council of Ministers No. 8-5. The D-5U complex with R-27U missiles is equipped with Project 667AU nuclear-powered missile submarines under construction (4 units), as well as Project 667A boats after modernization (8 things). In total, at two shipbuilding enterprises (shipyards in the cities of Severodvinsk and Komsomolsk-on-Amur) from 1967 to 1972, 34 SSBNs of projects 667A “Navaga” and 667AU “Navaga” were put into operation (according to some sources, SSBNs built in Severodvinsk, had the designation “Navaga”, and in Komsomolsk-on-Am[illegible] “Burbot”). Missile carriers built according to the latest project, in addition to improved missiles, h[illegible] their own noise level, modernized navigation complex and communication systems, etc.In addition,

in 1981, SKB-385 completed the modernizat of the D-5 complex, associated with the replacement of the monoblock warhead with a monoblock warhead from the D-5U complex, which made it possible to increase the firing range (D-5M complex). During the modernization of the D-5 complex and the R-27 missile, no design modifications were made to the SSBN systems and the system missile system placed on the SSBN ("under the missile"). The algorithms of digital computer systems and databases related to the preparation of a flight mission and the operation of a new type of warhead were adjusted. The ground equipment is basically similar to that for the D-5 complex.

The modifications described above were the only ones: the initial resolution of the Council of Ministers of April 24, 1962, on the creation of the D-5 complex also provided for the creation of a missile with a homing warhead capable of hitting moving ships. The anti-ship version of the missile was designated R-27K (GRAU index 4K18). Testing of the complex with the R-27K missile began in December 1970.The cycle of ground tests at the Kapustin Yar test site included 20 launches (of which 16 were considered

successful). The diesel-electric submarine K-102 of Project 629, with 4 missile silos on board, was converted to carry missiles under the experimental Project 605. The first launch from a submarine was carried out in December 1972. And in November 1973, the tests ended with a two-missile salvo. A total of 11 launches were carried out, of which 10 were considered successful. During the last launch, the target cruiser was hit by a guided missile. In 1974, the rocket was put into trial operation.

In the 1990s, work was carried out to create launch vehicles based on submarine ballistic missiles being decommissioned. The Zyb launch vehicle was created on the basis of the R-27. The rockets were used in research experiments requiring microgravity. The period of weightlessness lasted from 17 to 24 minutes. "Zyb" could launch a payload with a volume of up to 1.5 m3 into suborbital orbit.The payload mass could reach 650 kg at a maximum orbital altitude of 1800 km or 1000 kg at an orbital



altitude of 1000 km. Three launches were carried out. On December 1, 1991, the Sprint module was launched using SKB-385 together with NPO Composite. The module was designed to test technologies for producing superconducting materials and carried 15 exothermic furnaces on board. On December 9, 1992 and December 1, 1993, the “Ether” module was launched with the “Medusa” biotechnological equipment weighing 80 kg. The module, proposed jointly with the Center for Space Biotechnology, is intended for research into the technology for purifying biological and medical preparations using electrophoresis under zero-gravity conditions.

The D-5 complex was in operation from 1968 to 1998. In total, about 1,800 missiles were produced, 492 missile launches were carried out, of which 429 were considered successful. The maximum number of launches was in 1971 - 58. This is a kind of record for Soviet and Russian ballistic missiles from submarines.The complex also holds the record for the average annual number of launches - 23.4.

During operation of the D-5U complex, 161 launches were carried out, of which 150 were successful. The last launches of R-27 and R-27U missiles according to combat training plans were carried out in 1988. After this, launches were carried out only for research purposes. During operation (once each in the Northern and

Pacific fleets), 8 missiles were launched in salvo. All launches were considered successful. Over the entire period of operation, more than 10 thousand missiles were loaded and unloaded; boats armed with RSM-25 carried out 590 combat patrols in various areas of the World Ocean.

During operation, several accidents occurred with the destruction of missiles. 6 people were killed and one SSBN was lost. During loading with a violation of the loading and unloading process, a rocket with a height of 10 m fell onto the pier. The oxidizer tank was destroyed. Two people from the loading party died from exposure to oxidizer vapors on unprotected respiratory organs. A rocket was destroyed three times in the silo of a boat on combat duty.In 1973, on the boat K-219 was at a depth of 100 m due to a


North Korea's rapid advancement in missile technology linked to Ukrainian factory

Brandon Morse 56 mins

According to experts and government intelligence officials, North Korea has likely been getting its missile technology from a Ukrainian missile factory that had fallen on hard times. (Getty Images)

false operation of the irrigation system when the mine drainage valve and the manual valve on the jumper between the main drainage line of the boat and the drainage pipeline were open, communication between the missile silo and sea water occurred. The pressure was 10 atmospheric. destroyed the rocket tanks. While draining the mine, rocket fuel ignited, but the timely operation of the automatic irrigation system prevented further development of the accident. The boat returned safely to base. During the Ocean-76 exercise, three missiles were pre-launched on the K-444 boat. Two missiles were launched, but the third missile was not fired. Due to a series of human errors, the pressure in the tanks was released before the boat surfaced. The seawater pressure destroyed the rocket tanks, during the ascent and draining of the shaft, the oxidizer leaked into the shaft. Thanks to the skilful actions of the personnel, the development of an emergency situation did not occur. The third incident

also occurred on the K-219 boat on October 3, 1986.For unknown reasons, during the dive after a communication session, water began to flow into the missile silo. The crew tried to turn off the automation and drain it using non-standard means. As a result, the pressure first became equal to the outboard pressure, and the rocket tanks collapsed. Then, after draining the mine, fuel components ignited. The disconnected automatic irrigation system did not work, and an explosion occurred at a depth of 85 meters. The explosion tore off the cover of the missile silo (see Photo), and a fire started in the 4th missile compartment. During the fire and smoke in the 4th and 5th missile compartments, 3 people were killed, including the commander of the warhead-2. The crew was unable to extinguish the fire with their own efforts; the missile carrier lost energy and speed. Later, during the procedure for decommissioning the power plant, another person died. An attempt to organize the towing of the SSBN to Cuba with the help of approaching Soviet ships was unsuccessful. The compartments began to fill with sea water, and after more than 3 days of heroic struggle for survivability, the crew was forced to gradually abandon the damaged missile carrier, which sank on October 6 at a depth of 5.65 km in the area 1000 km northeast of Bermuda.This disaster, taking into account the Chernobyl radiation disaster that occurred just 5 months earlier and the radiation psychosis that appeared in the world, dealt a new serious blow to the international prestige of the USSR. The operating experience of RSM-25 missiles was analyzed and taken into account when developing new complexes. As a result, during the operation of SLBMs with liquid rocket engines of the First modifications, there was not a single case of loss of life.

The first missile carriers of Project 667A began to be withdrawn from the fleet in accordance with Soviet-American agreements in the field of arms reduction already in 1978 in order to maintain the number of nuclear weapons carriers at a certain level. Some of the missile carriers were converted into special-purpose submarines (2 units, projects 09774 and 09780), some were transformed into submarines with strategic Granat SLCMs (3 units, project 667AT). One missile carrier was modernized under Project 667M with the purpose of the Meteorit strategic SLCM. Other conclusions are for conservation with cutting out the missile compartment and disposal.The R-27U modification was withdrawn from service even before the collapse of the Soviet Union, in 1989. Other versions of the missile were withdrawn from service in Russia in compliance with the START-1 treaty. According to the September 1990 memorandum, 192 nuclear warheads were deployed on the R-27 on the territory of the USSR (192 SLBMs, 16 SSBNs at 3 bases [Yagelnaya at KSF , “Rybachy” and “Pavlovskoye” at KTOF]; another 142 SLBMs) were stored undeployed at the same bases). In addition, 173 non-deployed R[illegible]5 SLBMs were located at 3 SLBM storage points (Okolnaya, Revda and Nenoksa) and the Pashino SLBM

conversion and installation facility. As of J 1997, Russia had 16 deployed warheads on the R-27 (1 SSBN). By 1998, all R-27 missiles were taken out of service.

The relatively short range of Soviet missiles necessitated combat patrols by Soviet SSBNs using powerful anti-submarine defense forces of the US Navy and NATO (especially in the 80s). . However, despite the shortcomings, the USSR managed to create a fairly effective strategic missile system, and thanks to the Soviet strategic nuclear forces they entered a qualitatively new stage of their development.The appearance in the Navy of a significant number of completely modern SSBNs with a significant number of SLBMs at each level will increase the likelihood of delivering a guaranteed retaliatory strike, primarily taking into account the accuracy of the new missiles, according to the so-called. “soft” targets - political, economic and industrial centers. A number of new technical solutions were tested for the first time on the R-27 rocket. The use of these developments on missile systems in the future will completely eliminate the gap with the United States in this class of weapons, and in a number of tasks (astroinertial control systems, intercontinental-class SLBMs, etc.) and get ahead of the United States.

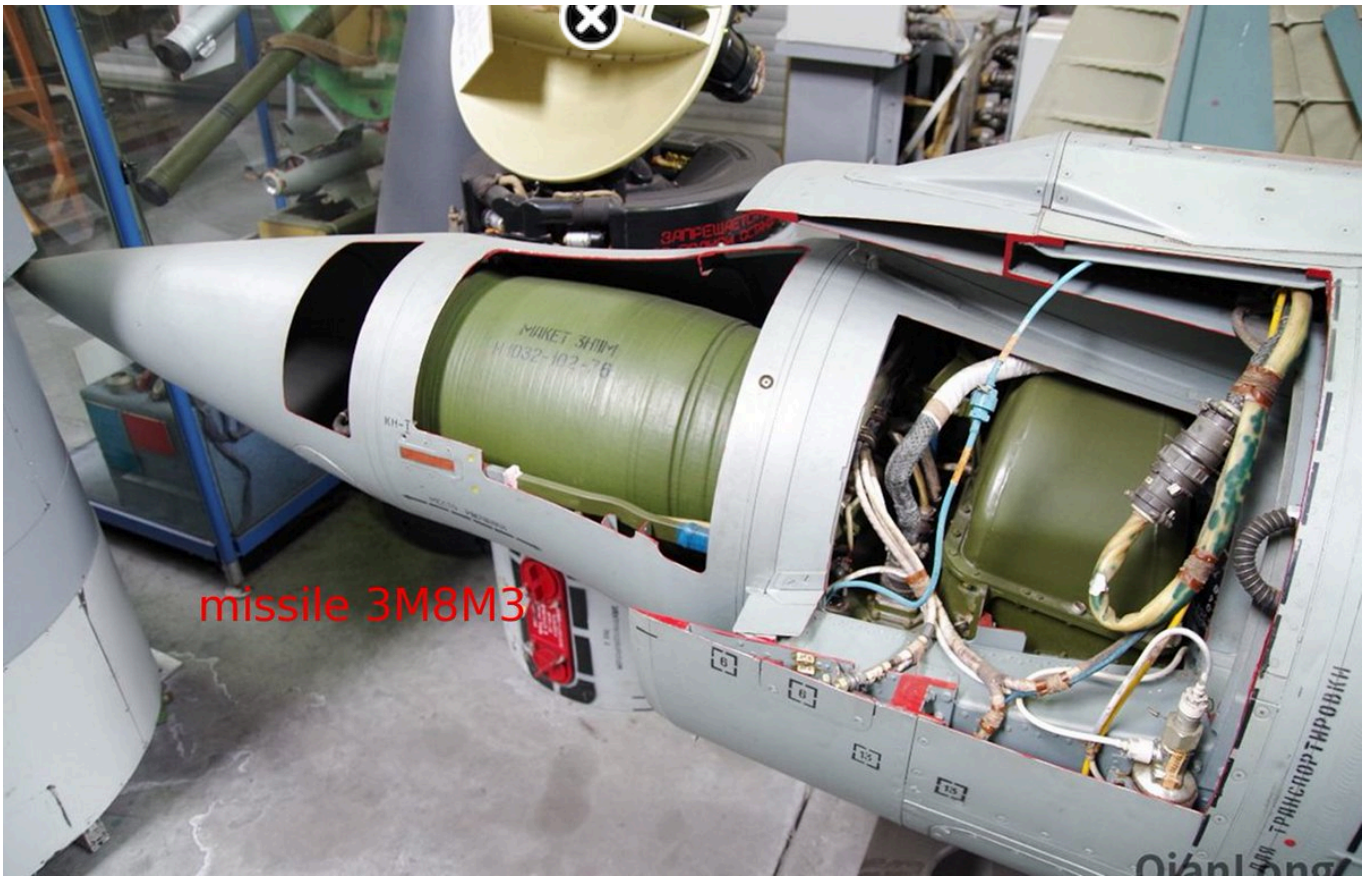
R-27 missile "Western" designation SS-N-6 Serb mod.1, modifications of R-27U - SS-N-6 Serb mod.3 and mod.2, R-27K - SS-NX-13. Project 667A (AU) missile carriers had the code designation Yankee.

R-27 submarine-launched ballistic missile

03/13/2019

In 1963, the D-4 complex with the R-21 missile was adopted into service with the submarine forces of the USSR Navy.For the first time in domestic practice, it was possible to implement an underwater launch of a missile, which had a positive effect on the survivability of carrier submarines and the effectiveness of the use of missiles. However, there was still a noticeable lag behind the likely approximation. By this time, the US Navy already had UGM-27B Polaris A-2 missiles with a range of up to 2800 km and operated submarines capable of carrying 16 similar products. A new qualitative leap was required, a way to reduce or eliminate the existing backlog. The response to such circumstances was the appearance of the D-5 missile system, armed with the R-27 missile.

The decision to create a new weapons system for submarines was made in April 1962 and enshrined in a resolution of the Council of Ministers. The defense industry was required to develop a promising nuclear submarine and arm it with a new missile system. The missile of this complex should be able to deliver a special warhead to a range of up to 2500 km.In addition, a modernized version of the missile with improved characteristics can be created. The project of the promising complex rec



the designation D-5, the missiles for it - R-27 (Navy missile and artillery control index - 4K10). The nuclear-powered carrier submarine received the designation "667A".

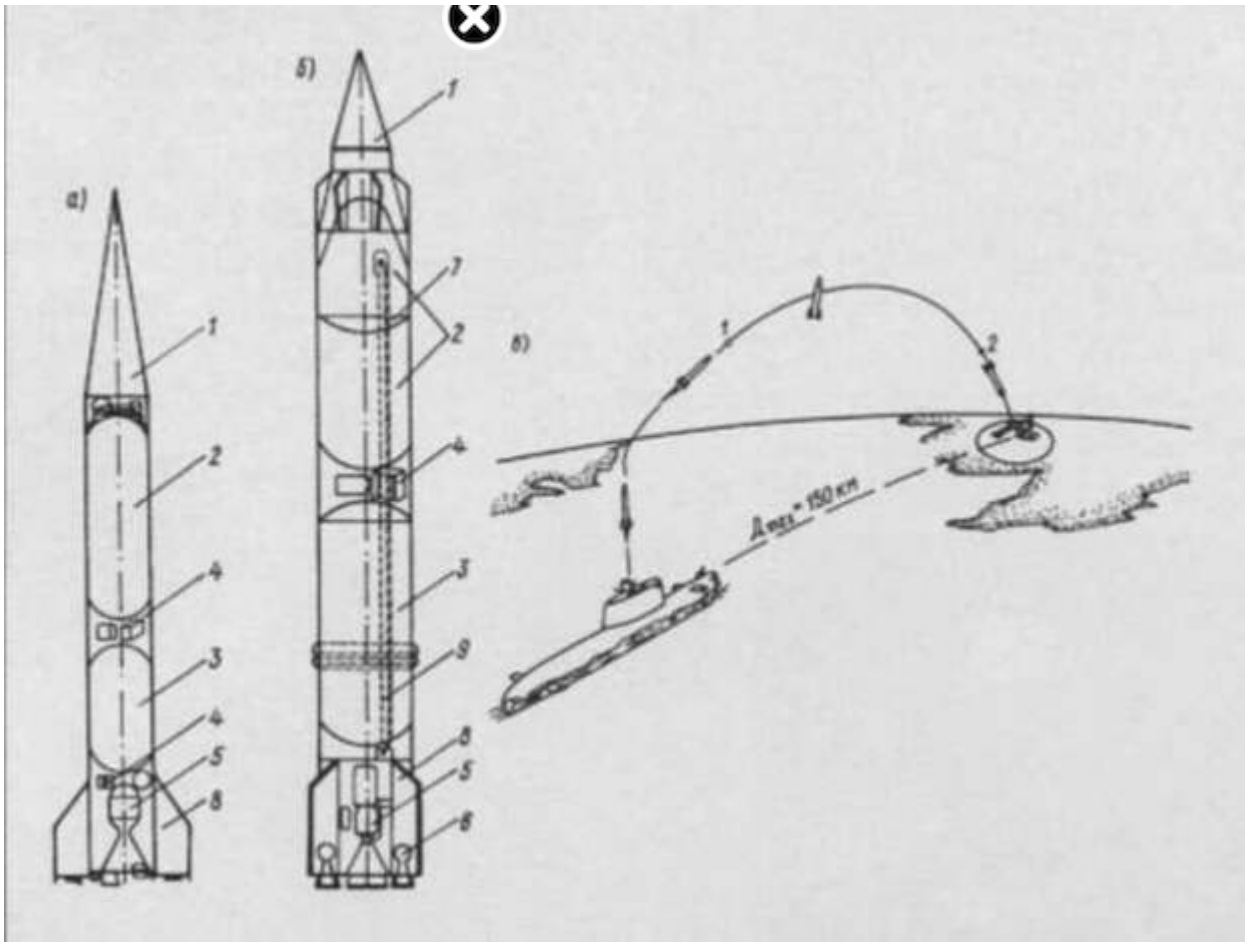
The transfer was presented with several extremely constructive difficult tasks. Create a small-sized ballistic missile with long range and enhanced performance. Early research has shown that meeting new demands requires abandoning well-established and time-tested ideas. New ideas were required in the field of unit layout and other non-standard solutions, new products, etc.

During the first results of the R-27 project, several original proposals were formed, which were later applied in the creation of a new rocket. Moreover, these developments were used in new rocket technology projects. It can be argued that within the framework of the D-5 / R-27 project, the initial final formation of the modern appearance of domestic ballistic submarine missiles.

The main “stimulus” for the emergence of new ideas and solutions was the requirement to reduce the size of the rocket. To reduce the size of the product with an increased increase in flight speed in comparison with existing samples, it is necessary to use a more dense arrangement of internal dimensions. First of all, it was decided to abandon the traditional layout of the hull with a pronounced division into compartments. Instead, the internal volume should be divided by partitions for various purposes. It was also decided to abandon aerodynamic stabilization in flight, which makes it possible to reduce the transverse dimensions of the product.

The body of a single-stage R-27 rocket must have a complex shape and formed surfaces. The fairing was made of two conical surfaces and a hemispherical head part. The rest of the rocket body was

made in the form of a cylinder with a slightly



narrowed tail section. Stabilizers or other large protruding parts were not provided. At the same time, four transverse belts of rubber-metal shock absorbers were placed on the outer surface, holding the rocket inside the internal installation in the required position.

The supporting body was made of so-called. wafer shells made of aluminum-magnesium alloy AMg-6 using chemical milling technology and connected by welding. This design with minimal weight of parts. To protect against water after the system was launched during flight, the body received a special coating based on asbestos textolite.

The head part of the rocket (the upper conical part and part of the lower part) contained the warhead. Immediately behind it were the control systems. It is noteworthy that the R-27 missile is not related to the familiar term. The control equipment was not placed in a separate compartment of the body, but in a small sealed volume formed by the bottom of the warhead and the hemispherical upper bottom of the oxidizer tank.

Most of the hull was given over to tanks for fuel and oxidizer. An important feature of the tanks was the use of common walls that act as a load-bearing hull. The internal volume of the tank body is divided by bottoms. One divided the oxidizer into two sizes, and the second, which had a double design, separated the oxidizer and fuel tanks.This technical solution is to abandon the intertank compartment and thereby the size of the rocket.

Another solution aimed at reducing dimensions was the original placement of the engine. The fuel tank received a bottom bottom of a complex shape, which involves “drowning” the engine inside the tank. This led to an additional reduction in size without compromising other characteristics.

Especially for the new rocket at OKB-2 under the leadership of A.M. Isaev developed a 4D10 liquid engine running on asymmetrical tetilhydrazine and nitric oxide. The engine design included a propulsion block with a thrust of 23 tons and a steering rod of 3 tons. The engine was equipped with turbopump units for supplying fuel and oxidizer. The propulsion block of the engine used afterburning of oxidizing gas and was equipped with a fuel flow regulator, with the help of which the thrust should be changed. The steering unit did not burn out the oxidizing gas, and its thrust should be adjusted by changing the supply of oxidizer to all chambers.For control, oscillating steering block cameras were used, mounted at an angle of 45° to the rocket stabilization planes.

In order to simplify the design and improve performance characteristics, the engine was made maintenance-free. When commissioning the engine, it was proposed to use only permanent connections, such as soldering or welding. Such a design required a set of special adapters of a bimetallic design, consisting of steel and aluminum parts. To start, the engine was equipped with a single squib and its own automation necessary to bring it into operating mode.

For the first time in domestic practice, a ballistic missile for the fleet should be refueled at the manufacturer. It was proposed to fill in the fuel and oxidizer at the final stage of assembly, after which the refueling and drainage pipes should be welded. The ampulized missile could be stored at bases and launchers for five years. Subsequently, taking into account the operating experience of the new weapon, the shelf life was tripled.

Another innovation concerned the design of the control system. The autonomous inertial guidance system is located in a sealed volume formed by the bottoms of other units. At the same time, the R-27 became the first domestic missile for submarines, the control system of which used a gyro-stabilized platform. The latter is used to install sensitive elements. A guidance system with improved characteristics made it possible to fire from a CEP of no more than 1.9 km when launched at maximum range.

For the R-27 missile, NII-1011 installed a special warhead weighing 650 kg with a capacity of 1 Mt. The warhead was detachable using an elongated high explosive charge. When creating a new warhead, the designer had to face some layout problems. However, all the tasks were successfully solved, resulting in the emergence of a new type of warhead, different from other products for the R-21 missile, with approximately half the dimensions without loss of power.

The new ballistic missile differed from similar products in its smaller dimensions. The length of the R-27 did not exceed 9 m, the diameter was 1.5 m. The launch weight was 14.2 tons. The liquid engine could accelerate the missile to a speed (at the end of the active section) 4, 4 m/s, output to an alti[illegible]of up to 120 km. After completing the active section, there should be a reset of the warhead, which

continued to fly independently. The maximum firing range was 2500 km, with the warhead rising to a height of 620 km. When meeting a target, the warhead developed a speed of up to 300 m/s.

To use the R-27 missile, the carrier submarine had to receive a new type of silo launcher. This unit is a durable cylindrical block with an openable top cover and a set of necessary equipment. The launcher received a launch pad of a new design, which should be connected to a special adapter in the tail of the rocket. The task of these units was to create the so-called.n. gas bell, which, when started, reduces the pressure inside the shaft to acceptable values. The launcher is also a set of sealed connectors for connecting the rocket with the onboard equipment of the carrier.

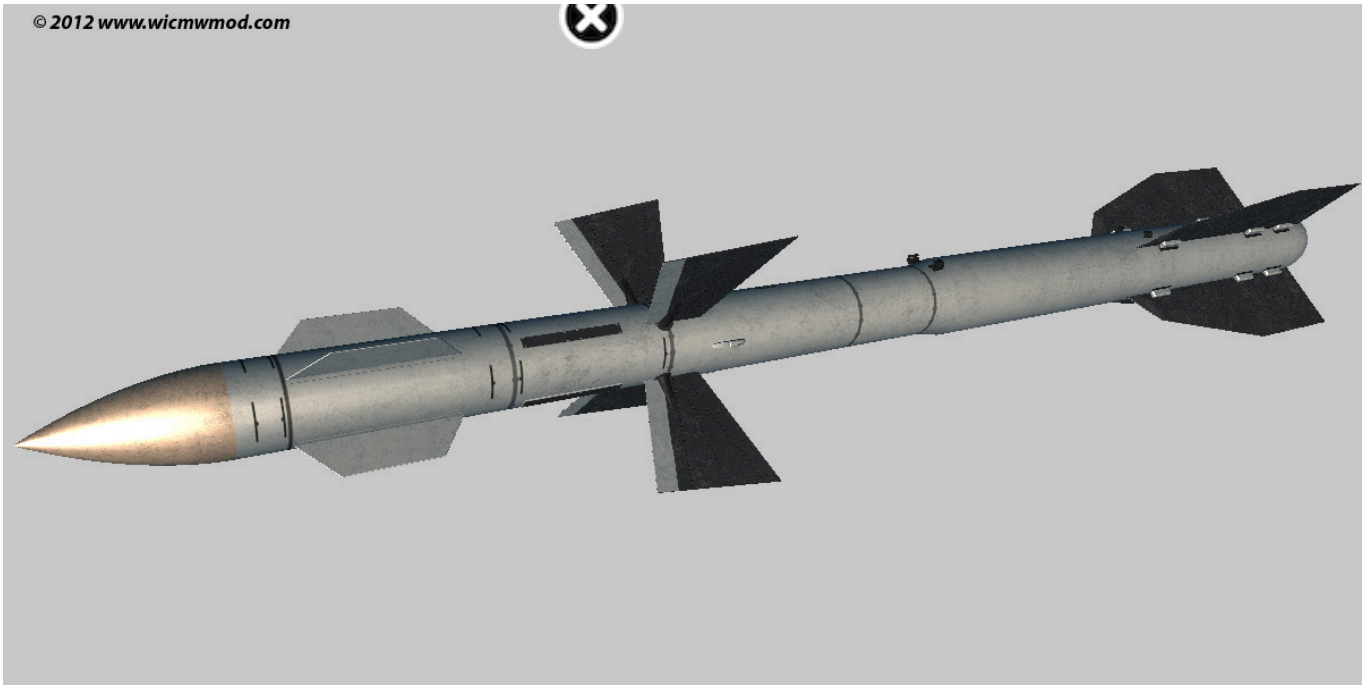
The carrier submarine must be equipped with a set of special equipment designed to monitor the status of the missiles. At the same time, monitoring compliance with the single remote control regime. Carrying out routine checks, pre-launch preparation and shooting were controlled with a different remote control. To develop a flight mission and enter data into the missile control system, the “Tucha” combat information and control system was proposed.

The R-27 missile had the ability to launch underwater using a “wet” scheme. Before launching, the cover of the annular gap of the launch shaft had to be filled with sea water, after which it was possible to open and launch. During the launch, the liquid engine must start the steering motors, with the help of which the gas bell was created. After the ascent began, the propulsion engine had to turn on, with the help of which the rocket could leave the silo and fly out of the water.

Testing of the new rocket was planned to be carried out in three stages, the purpose of which was to test the product in various conditions. The first tests took place in September 1965 using a submersible stand. Two (according to other sources, up to six) full-scale R-27 missiles were used in throwing tests, during which the process of the missile exiting the silo was checked.

In June 1966, the second stage of testing began, lasting until the spring of 1967. At the Kapustin Yar test site, 17 launches of experimental missiles were carried out against conditional targets. 12 launches were considered successful. Completion of tests with a land-based launcher, begin testing with submarines.

Back in 1964, modernization of the submarine S-229 began, at that time it was a representative of the experimental project 613D7 and used as an experimental carrier of the RT-15M missile, according to project 613D5. The existing launcher was removed from the boat, and a smaller silo for the R-27 missile was installed in its place.In addition, it received a set of new equipment necessary for the maintenance and use of such missiles. In January 1967, the S-229 went to sea for the first time t new weapons.



On January 18, the S-229 submarine, being at a depth of 45 m and moving at a speed of 3 knots, launched a full-scale prototype of the R-27 missile for the first time at a sea level of 3 points. Until August 10 inclusive, five more launches were carried out. All tests using the Project 613D5 boat were successful.

In the summer of 1967, the third stage of testing began, in which the standard carrier of the D-5 complex was used - the K-137 Leninets nuclear submarine of Project 667A Navaga. Launches began in August, during which six missiles were used. These joint tests were completed successfully, after which the D-5/R-27 missile system was recommended for adoption.

On March 13, 1968, a new missile and a complex for it were adopted by the submarine forces of the USSR Navy. By this time, full-scale serial construction of Project 667A submarines had begun.Such

submarines carried 16 launchers located in two rows along the hull in the fourth and fifth compartments. Until the mid-seventies, the fleet received 34 Navaga-class submarines of several modifications, which were distributed among various formations. In total, they could simultaneously carry 544 R-27 missiles.

Since the early sixties, the anti-ship R-27K was developed on the basis of the R-27 ballistic missile. Such a device received a semi-active radar guidance system and could hit moving targets in the form of ship formations. The R-27K project reached testing, but did not lead to the rearmament of the fleet and the expansion of the list of strike weapons. The new weapon was considered inconvenient and could have a negative impact on nuclear forces: the deployment of anti-ship ballistic missiles required submarines, which could affect the number of deployed strategic weapons. After testing was completed, the R-27K was abandoned, although work on similar systems continued.

In June 1971, a resolution of the Council of Ministers was issued on the modernization of the D-5 complex with the R-27 missile. Two options are required to increase the distance between the two upgrade options, one of which must be a separable warhead with warheads. The updated complex was designated D-5U, the missile for it was R-27U.

The first modernization option is used to preserve all options for using the rocket when using a new warhead. On a general basis, it was now proposed to mount three dropable warheads with a capacity of 250 kt each. At the end of the active phase, the rocket must release its warheads and give them a small lateral speed. It was assumed that in this case, warheads of reduced power would fly at a certain distance from each other and fall in the target area, with a higher degree of probability of hitting it.

The R-27U missile of the second version received a lightweight warhead with a capacity of 1 Mt, thanks to the firing range it was possible to increase it to 3000 km.The principles of operation of the systems of systems remained unchanged, although some design modifications were required.

An updated control system has been improved for two versions of the R-27U missile. Due to the improvement of its instruments, the CEP was reduced to 1.3 km. In this case, the power of the warhead fully compensates for the miss and guaranteed destruction of the target.

From September 1972 to August 1973, flight tests of new missiles were carried out. Based on the test results, the D-5U missile system and the R-27U product were put into service in early January 1974. In connection with this D-5U complex, four boats of the updated project 667AU “Nalim” were installed during construction. Eight more carriers of the new missiles were converted from Project 667A boats.

The last modernization of the D-5 missile system was carried out in the early eighties. The R-27 missile in the configuration was re-equipped with a lightweight monoblock warhead from the R-27U

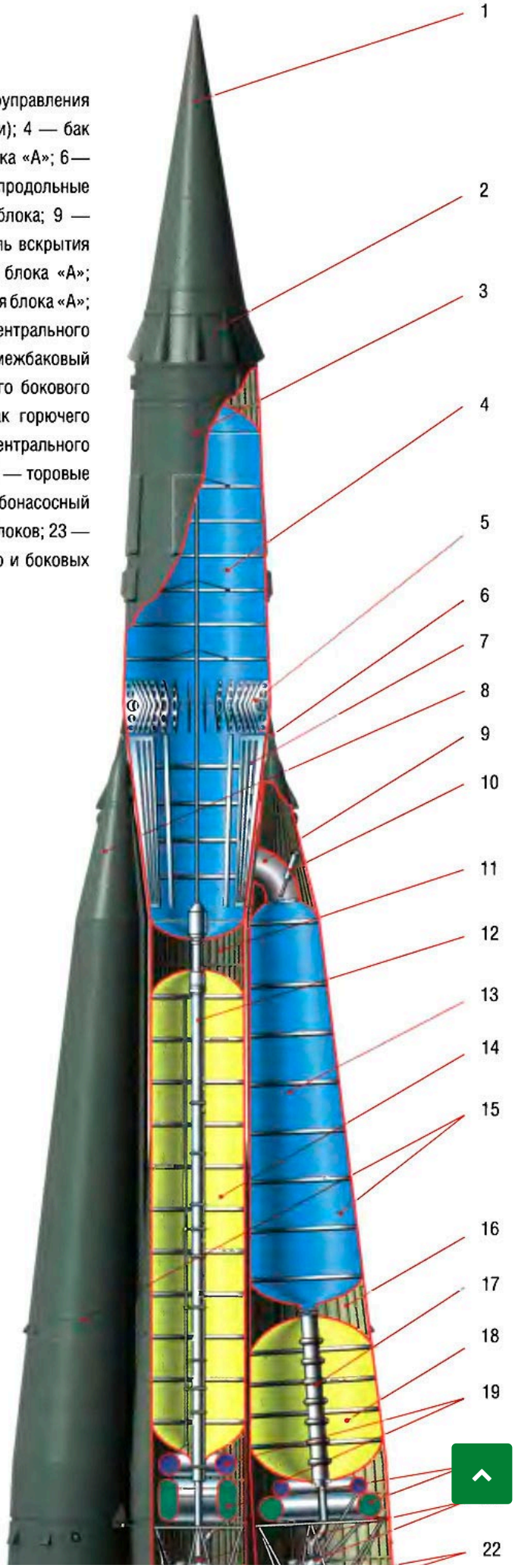
product. This allows you to increase the firing range to 3000 km.A similar

modernization of the complex is known as D-5M.

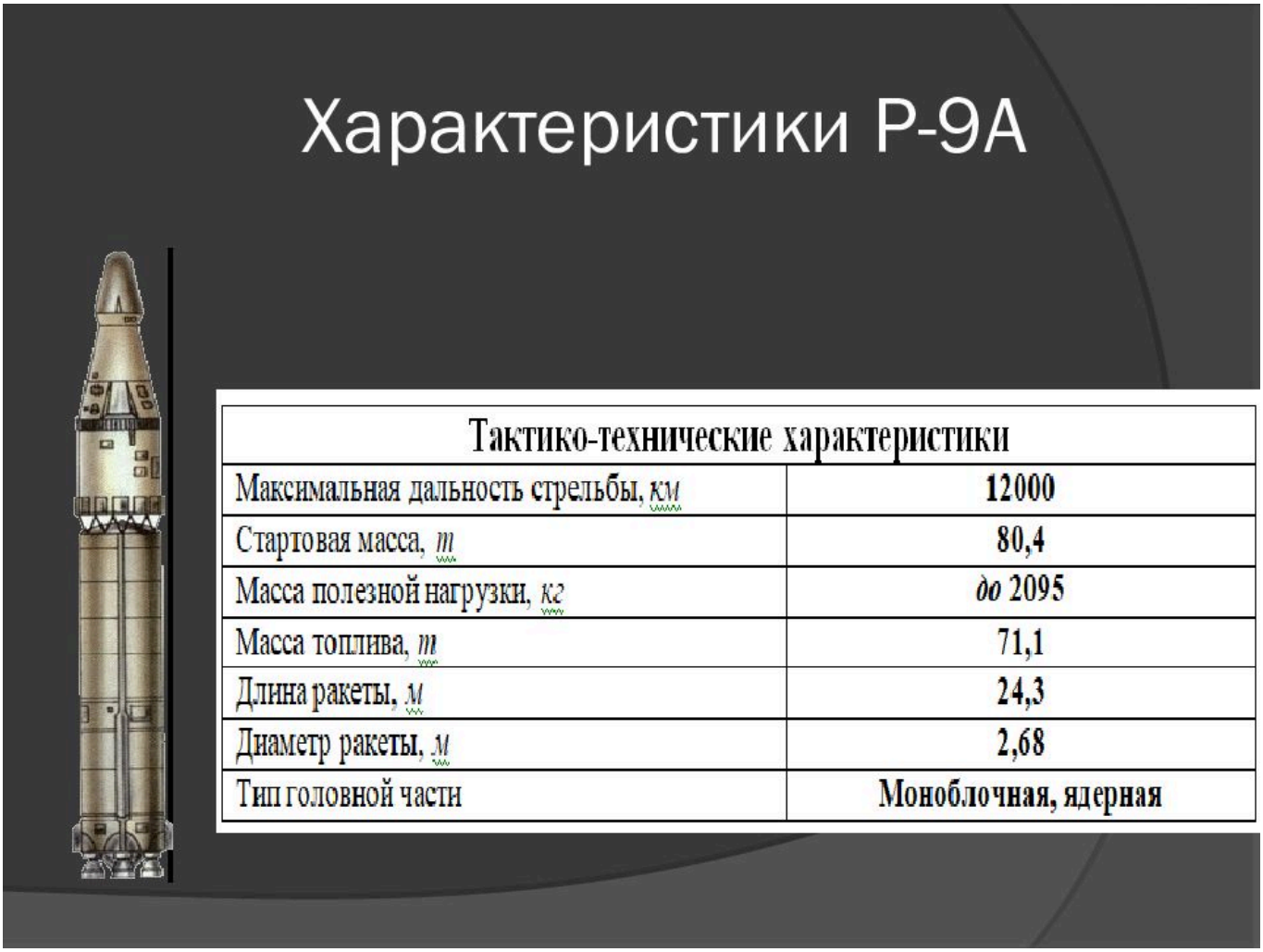
Full operation of the D-5 family of missile systems continued for two decades, until 1988. During this time, fleet specialists completed more than 10 thousand rubles. loading and unloading operations to ensure 590 submarines went on combat duty. 492 missile launches were carried out, of which 429 ended in the successful defeat of training targets. In 1971, nuclear submarines of the 667A family set a record with a total of 58 launches. This achievement has not yet been surpassed. On average, 23.4 missiles were used per year. Of the 492 launches, 161 were on D-5U complexes. R-27U missiles completed assigned combat training tasks 150 times.

Конструктивно-компоновочная схема баллистической ракеты Р-7

1 — головная часть; 2 — приборный отсек, отсек системы радиоуправления (РУ); 3 — центральный блок (блок «А», блок второй ступени); 4 — бак окислителя блока «А»; 5 — силовой (опорный) шпангоут блока «А»; 6 — опорный кронштейн шаровой опоры бокового блока; 7 — продольные демпферные перегородки; 8 — силовой конус бокового блока; 9 — газоход системы разделения ступеней; 10 — пневмотолкатель вскрытия верхнего днища бака окислителя; 11 — межбаковый отсек блока «А»; 12 — тоннельная труба с расходным трубопроводом окислителя блока «А»; 13 — бак окислителя бокового блока; 14 — бак горючего центрального блока; 15 — боковые блоки (блоки «Б», «В», «Г», «Д»); 16 — межбаковый отсек бокового блока; 17 — тоннельная труба бака горючего бокового блока с расходным трубопроводом окислителя; 18 — бак горючего бокового блока; 19 — тороидальный бак перекиси водорода центрального блока и торовые баки перекиси водорода боковых блоков; 20 — торовые баки жидкого азота боковых и центрального блоков; 21 — турбонасосный агрегат; 22 — маршевые двигатели центрального и боковых блоков; 23 — аэродинамический руль; 24 — рулевые камеры центрального и боковых блоков



Of particular interest are the combat training activities carried out twice by submariners of the Northern and Pacific fleets. On December 20, 1968, the K-140 submarine of the Northern Fleet fired a salvo of eight missiles (according to other sources, two salvos of eight missiles).One of the Pacific Fleet



boats carried out similar shooting ahead.

Unfortunately, there were accidents and losses. The first serious incident (the exact location and date of the incident is unknown, probably the early seventies) led to the death of two people. During the loading of the rocket onto the carrier submarine, due to incorrect actions of the device and the design of the structure, the product and the traverse structure were distorted. The distortion led to the rocket breaking off its mounts and falling onto the pier. The fuel tank survived, but a hole appeared in the oxidizer tank. Two participants in the work were poisoned by oxidizing vapors. Based on the results of this incident, the missile loading system was modified.

In 1976, an accident occurred on the submarine K-444, but its crew managed to prevent negative consequences. Due to improper preparation of three R-27 missiles for launch, the silo was filled

sea water and the structure of the tanks was damaged. After surfacing and draining the silo, this led to an oxidizer leak. The crew took the necessary measures and prevented a fire.

Two accidents occurred on the Project 667A submarine K-219, the second leading to its loss. In 1973, the launcher's automation allowed the silo filling valves to open, which led to damage to the rocket by seawater pressure. When draining the launcher, fuel components leaked from the damaged tanks and caught fire, but automatic irrigation prevented the fire from developing. The submarine returned to base and underwent repairs.

On October 3, 1986, K-219 again encountered problems. For unknown reasons, when the boat was submerged, water began to penetrate into one of the launch shafts. The crew's attempt to drain the mine using non-standard means with the automation switched off was unsuccessful, but led to an increase in pressure and destruction of the rocket. This time, the turned off automatic irrigation system could not prevent the fire. The fire led to an explosion with the launcher cover being torn off and the fire spreading to the fourth compartment. Due to the impossibility of extinguishing the fire on their own, the crew was forced to evacuate and scuttle the boat.Three submariners died in this accident.

It should be noted that, despite all the incidents, the D-5 / R-27 missile system also proved to be a reliable weapon for submarines. At the end of the eighties, the systems began to be removed from service due to morale and obsolescence, as well as due to the signing of new international agreements. Thus, in connection with the implementation of the START-1 treaty, by the end of the nineties, no more

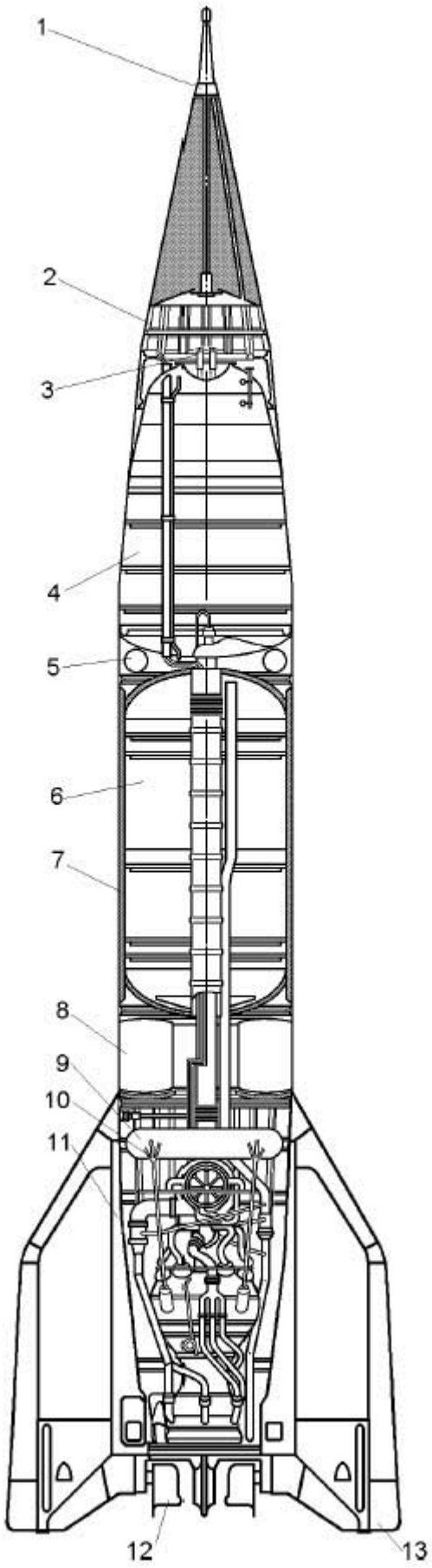
than 16 R-27 missiles were developed in the submarine forces . Soon they were removed from service. In the early nineties, the Zyb launch vehicle was launched on the basis of the ballistic R-27. The main purpose of these products was to carry special research equipment designed to operate in microgravity conditions. It was possible to launch a cargo with a volume of 1.5 cubic meters weighing up to 1 ton into a suborbital trajectory. The 1000-kg cargo could reach an altitude of 1000 km, the maximum altitude of 1800 km was achieved with a cargo weighing 650 kg.

On December 1, 1991, December 9, 1992, and December 1, 93, three launches of Zyb rockets were carried out with scientific apparatus of different types and for various purposes.After this, the operation of the new type of launch vehicles ceased.

The D-5 complex and the R-27 missile, designed to arm submarines, were in operation for several decades and occupied an important place in the strategic nuclear forces of the Soviet Union. In addition, serious design and technological advances were achieved within the framework of this project. In the R-27 project, for the first time in domestic practice, several important solutions were introduced, which later became a standard in the development of new ballistic missiles for submarines. In addition, the 667A submarine project was created for the D-5 complex, the further development of which will significantly strengthen the naval component of the nuclear triad and maintain its potential for a long time.

Military review.

Leave feedback:



R-27 (air-to-air missile) - R-27 (air-to-air missile)

Air-to-air missile

This article is about the air-to-air missile. For submarine ballistic missiles, see R-27 Zyb. For other uses, see R27.

Medium range type, tactical air-to-air missile, anti-radiation missile

R-27 **AA-10 Alamo**	
Type	Medium range tactical air-to-air missile, anti-radiation missile
Place of origin	Soviet Union
Service history	
In service	1983–present
Wars	Iran-Iraq War Eritrean-Ethiopian War War in Donbass Civil War in Yemen (2015 to present) Saudi Arabia's intervention in Yemen
Production history	
Manufacturer	Pennant
Unit cost	No data
Characteristics	
Weight	253 kg (558 lb)
Length	4.08 m (13.4 ft)
Diameter	230 mm (9.1 in)
Warhead	explosive/fragmentation or solid rod
Warhead weight	39 kg (86 lb)
Detonation mechanism	radar proximity and impact fuses

Engine	High performance, W.Directional rocket motor Solid fuel rocket motor
Wingspan	772 mm (30.4 in)
Operating range	R-27T: up to 40 km R-27R: up to 73 km R-27P: up to 80 km R-27ER: up to 130 km R-27ET: up to 120 km R-27EP: up to 130 km R - 27EA: up to 130 km R -27EM: up to 170 km
Flight altitude	No data
	Mach 4.5
Guidance system	semi-active radar homing (A/C), active radar homing (R-27EA), infrared homing (B/D), passive radar homing (E/F)
Launch platform	Su-27, Su-30, Su-33, Su-34, Su-35, Su-37, F-14 (made by Iran), MiG-23, MiG-29, Yak-141, Su-57, local conversion into an anti-aircraft missile in Yemen

R-73Ae, R-27R1 (AeR1), R-27T1 (AeT1) and X-59MAe at MAKS, Zhukovsky, 1999.

The Vympel R-27 missile (NATO reporting name **AA-10 Alamo**) is a medium to long range air-to-air missile developed by the Soviet Union. It remains in service with the Russian Air Force and the Air Force of the Commonwealth of Independent States.

The R-27 is produced in infrared (R-27T), semi-active radar homing (R-27R) and active radar homing (R-27EA) versions in both Russia and Ukraine. The R-27 missile is installed on fighter aircraft The Mikoyan MiG-29 and Sukhoi Su-27, and some later model MiG-23MLD fighters were also adapted to carry it. The R-27 missile is also manufactured under license in China, although the production license was purchased in Ukraine, not Russia.

Options

9B-1101K, inertial semi-active homing head for R-27R missiles.

- **R-27R** AA-10 Alamo-A , semi-active hom[illegible] radar. The missile can be installed at an altitude of 20 to 25,000 meters (launch pad or target).Effective range to hit a target at the same altitude: from 2 to 42.5 km frontal, from 0.7 to 7.5 km tail. Maximum range: 73 km. Maximum permissible vertical separation between target and launch platform: +/- 10 km.
- **Р-27Т** АА-10 Аламо-Б , инфракрасное самонаведение, пассивное самонаведение с помощью ИК-самонаводящейся головки «Автоматика 9Б-1032» (ПРГС-27).Ракета может установить на высоте от 20 до 25 000 метров. Эффективная дальность цели на той же высоте: от 2 до 33 км в лоб, от 0 до 5,5 км в хвостовой части. Максимальная дальность: 63 км. Максимально допустимое вертикальное разделение: +/- 10 км.
- **Р-27ЭР** АА-10 «Аламо-С» , полуактивная радиолокационная версия повышенной дальности самонаведения. Ракета может установить на высоте от 20 до 27 000 метров. Эффективная дальность поражения цели на той же высоте: от 2 до 65,5 км лобовым, от 0,7 до 16,5 км хвостовым.Ракета не может быть запущена на высоте 3 км по цели на фоне земли, если дальность пуска менее 6 километров. Максимальная дальность: 117 км. Максимально допустимое вертикальное разделение: 12 км.
- **Р-27ЭТ** АА-10 «Аламо-Д» , вариант с инфракрасным самонаведением и дальностью действия. Масса 348 кг. Ракета может установить на высоте от 20 до 27 000 метров. Эффективная дальность поражения: от 2 до 52,5 км в лоб, от 0,7 до 12,5 в хвост. Максимальная дальность: 104 км.Максимально допустимое вертикальное разделение: 12 км.

Варианты Р-27Р и ЭР назад в любых метеорологических условиях. Пуск может производиться при перегрузке менее 5 г и скорости крена менее 50 град / с. Допускается изменение обозначения целей во время полета или совместное освещение цели с другими самолетами.

Варианты R-27T и ET Местонахождение внечности, по крайней мере, на 15 градусов от пеленга солнца от пеленга Луны и в условиях контрастного тепла на земле.В пуска на максимальную дальность, когда заблокируется не может быть случаев, ракета может быть запущена в режиме PPS: в этом режиме ракета будет лететь прямо, пока не достигнет захвата цели. Чтобы ракета была направлена под углом не более 15 градусов к цели для уверенного захвата инфракрасной ГСН после пуска, ракета должна быть направлена под углом не более 15 градусов. Выравнивание рекомендуется, но не требуется. В разделе «Боевые действия» по руководству Су-27 этот режим использования рекомендуется для лобового использования для пассивных атак по целям с углом приближения 0 градусов (т.е. другой истребитель движется на перехват), оставляя цель незаметной для приближающейся ракеты. Запус[illegible] может производиться при весе от 0 до 7 г , но ограничен до 6 г, , если проскальзывание, вызванное качением, диаметр шара более чем в 2 раза.

Другие варианты:

- **Р-27П** АА-10 Аламо-Э , пассивная РЛС самонаведения с дальностью полета до 72 км.
- **Р-27ЭП** АА-10 Аламо-Ф , пассивная противорадиационная ракета большей дальности с дальностью до 70 нм (110 км)
- **R-27EA** , active homing radar with 9B-1103K seeker activity, range >130 km.
- **R-27EM** , active homing radar with 9B-1103K seeker activity, range >170 km.

Prompt service

Ethiopia and Eritrea

During the 1999 Eritrean-Ethiopian War, Eritrean MiG-29s fought Ethiopian Su-27s flown by Russian mercenaries. Perhaps 24 P-27s were fired from both sides. Only one R-27, fired by an Ethiopian Su-27 at an Eritrean MiG-29 with a proximity fuze, is close enough to the MiG for the damaged aircraft to eventually crash on landing.

Ukraine

During the War in Donbass, the Ukrainian Air Force stated that one of its Su-25s was shot down by a Russian Air Force MiG-29 using an R-27T on July 16, 2014. Russian officials denied any involvement.

Yemen

During the Yemeni Civil War (2015–present), the Houthis used R-27T missiles modified for use as surface-to-air missiles.The video, released on January 7, 2018, also shows a modified R-27T hitting a Saudi F-15 with its forward-facing infrared camera. Houthi sources claim they shot down the F-15, although this is disputed as the missile appears to have exploded close by, although The F-15 continued to fly along its trajectory, seemingly unharmed. Rebels later released footage showing the plane crashing, but serial numbers on the wreckage suggested it was a Panavia Tornado, also operated by Saudi forces. On January 8, the Saudi Press Agency acknowledged the loss of the aircraft over Yemen, but did not specify whether it was a Tornado or an F-15.

On March 21, 2018, Houthi rebels released a video of them shooting down and possibly shooting down a Saudi F-15 in Saada Governorate. The video showed an R-27T air-to-air missile, adapted for surface-to-air use, being launched and apparently successfully hitting the aircraft. As in the video of a previous similar hit recorded on January 8, the target, although clearly hit, was not shot down.Saudi forces confirmed the hit, saying the plane landed safely at the Saudi base. Official sources in Saudi Arabia confirmed the incident, saying it occurred at 3:48 p.m. local time after a missile-class missile was fired at a local fighter jet from Saada Airport. "ground-air defense".

Operators

Map with R-27 operators in blue with former operators in red

Current operators

Former operators

see also

Similar weapons

Recommendations

Quotes

Bibliography

- Gordon, Efim (2004). Soviet/Russian aircraft weapons after World War II . Hinckley, England: Midland Publishing. ISBN1-85780-188-1.

external links

Ballistic missile 4K10 R-27 (USSR)

SLBM R-27 (URAV Navy index - 4K10, START code - RSM-25) is a liquid-propelled single-stage ballistic missile for submarines.As part of the D-5 missile system, it was part of the armament of nuclear submarines of projects 667A and 667AU. The development of the missile was specified by Decree of the Central Committee of the CPSU and the Council of Ministers of the USSR dated April 24, 1962 No. 386-179ss. SKB-385 was identified as the lead developer. Chief designer - V. P. Makeev. The main purpose of creating the R-27 missile system is to eliminate the malfunction of the American missile system. During the development of the rocket, a number of innovative solutions were used, the best qualities of the R-27 rocket, and the developments of SKB-385. The so-called “drowned man”, the so-called “drowned man”, there was no traditional use of compartments, was not used, the internal volume for placement was maximally used it contains fuel components. The all-welded sealed body was made of wafer shells obtained by chemical milling of plates, the materials for which were aluminum-magnesium alloy. The volume of the air bell was reduced due to the sequential start-up of the steering engines, and then the main engine.And a number of other innovations. All these innovations made it possible to reduce the dimensions of the missile, but double the maximum firing range of the R-21 missile.

The R-27 missile was made according to a single-stage design with a monoblock detachable warhead. The rocket was equipped with a 4D10 liquid rocket engine developed by OKB-2, which consisted of two blocks: a propulsion block with a thrust of 23 tons and a steering block of two chambers with a total thrust of 3 tons. Unsymmetrical dimethylhydrazine (UDMH) was used as a fuel, and nitrogen tetroxide (AT) was used as an oxidizer. For the first time in the USSR, elements of the inertial control system (for SLBMs) were placed on a gyro-stabilized platform. The rocket was equipped with a monoblock detachable warhead weighing 650 kg. The power of the nuclear charge placed on it was 1 megaton. The missiles were launched from a depth of 40-50 meters at a boat speed of up to 4 knots and a sea state of 5 points. Pre-launch preparation time for rockets is 10 minutes. The firing interval of missiles in one salvo is 8 seconds.

The R-27 missile was put into service on March 13, 1968. Three years later, on June 10, 1971, a resolution was adopted by the Central Committee of the CPSU and the Council of Ministers of the USSR on the modernization of the missile system, which provided for, in the first version, equipping the missile with a warhead with three warheads, while maintaining maximum firing range, in the second option - increasing the range and increasing the accuracy of fire. The upgraded missile received the designation R-27U (GRAU code - 4K10U). As a result of the work carried out, a missile was created in three warheads with a capacity of 200 kilotons each with a maximum firing range of 2400 kilometers. The multiple warhead was not individually targeted - at the end of the section the blocks were “pushed” in different directions at low speed. According to the second option, a firing range of 3000 kilometers and a monoblock head power of 1 megaton were created. The circular probable deviation was 1.3 kilometers.

Ship tests of R-27U missiles took place from September 1972 to August 1973.16 launches were carried out, all of them were considered successful. The R-27U missile was adopted for service by Resolution of the CPSU Central Committee and the Council of Ministers of the USSR dated January 4, 1974 No. 8-5ss. The Project 667AU nuclear-powered missile submarines under construction, as well as the Project 667A boats after modernization, are equipped with a missile system with R-27U missiles.

The resolution of the Central Committee of the CPSU and the Council of Ministers of the USSR dated April 24, 1962 on the creation of the R-27 missile also created the development of a missile with a homing warhead capable of hitting moving ships. The anti-ship version of the missile was designated R-27K (GRAU index - 4K18). The rocket was equipped with a 2nd stage with a liquid rocket engine developed by OKB-2. To maintain the dimensions of the missile, the dimensions of the 1st stage were reduced, which was achieved to achieve a maximum firing range of up to 900 km. The warhead is monoblock, nuclear, with a capacity of 0.65 megatons. Despite the relatively early start of development of the R-27K missile, its testing began only in December 1970.The ground test cycle at the Kapustin Yar test site included 20 launches. Of these, 16 were considered successful.

To accommodate Project 605 missiles, the [illegible]2 Project 629 submarine was converted. The first launch from the submarine was carried out in December 1972. And in November 1973, the tests ended with a two-missile salvo. A total of 11 launches were carried out, of which 10 were considered successful. During the last launch, the target cruiser was hit by a guided missile. The R-27 missile was in service until 1988. During this period, 492 launches were carried out, of which 429 were considered successful. The maximum number of launches was in 1971 - 58. This is a kind of record for Soviet and Russian submarine-launched ballistic missiles. The complex also holds the record for the average annual number of launches - 23.4 launches.

Over the years it has been in service, 161 R-27U missiles have been launched. Of these, 150 launches were successful. The last launches of R-27 and R-27U missiles according to combat training plans were carried out in 1988.After this, launches were carried out only for research purposes. During the missile's operation, 8 missiles were launched in one salvo twice (once each in the Northern and Pacific fleets). All launches were considered successful. The R-27U missile was withdrawn from service in 1989. The Zyb launch vehicle was based on the R-27U SLBM.

Technical characteristics of 4K10 R-27
Length, m 8.89
Diameter, m 1.5
Launch weight, t 14.2
Warhead weight, t 0.65
Maximum range, km 2500
Circular probable deviation, km 1.9
Warhead type - mono
Head power, Mt 1

authors of the article: A.B. Zheleznyakov
primary source: "100 best missiles of the USSR and Russia"

R-27K anti-ship ballistic missile

Modern strike systems designed to destroy surface space devices are based on various types of winged ones. Such weapons have long shown themselves to be good and enjoy deserved popularity.However, in the past there have been repeated attempts to experiment with an anti-ship system based on a ballistic missile. Most projects do not lead to the rearmament of the armed forces, but it is important to gain experience. The first domestic anti-ship ballistic missile was the R-27K product.
In April 1962, the USSR Council of Ministers decided to begin development of a new medium-ra[illegible] ballistic missile intended for use by submarines. The missile system project received the designation

D-5, the missile itself - R-27. Miass SKB-385 (now the State Missile Center) was appointed as the project developer; V.P. was to supervise the work. Makeev. Work on the D-5/R-27 project led to the adoption of a new missile system in submarine arsenal in 1968.

Also in 1962, a proposal appeared to develop a modification of the R-27, intended for the purpose of destroying surface targets at ranges of up to 900 km. An anti-ship missile called R-27K or 4K18 should be based on R-27 aggregate products that have the characteristics of their intended purpose.Due to the need to use small-sized moving targets, the anti-ship missile must receive a set of new equipment, including homing systems.

R-27K missiles on a test bench. Photo Rbase.new-factoria.ru

Calculations showed that the first detection systems determined the identification of surface targets with an accuracy of 25-30 km. In this case, the time of pre-launch preparation, the target could move 100-150 km from the previously determined point. Thus, an anti-ship ballistic missile must be equipped with homing systems to independently determine the location of the target.

Already in 1962, the general architecture of the new product was proposed, which allows solving the problem. It was proposed to rework the existing rocket and make it a two-stage one. The task of the first stage in this case was to preliminary accelerate and launch the missile onto the required ballistic trajectory, and the second stage was supposed to find and hit the target. In addition, the preliminary design of the first version proposed ways to solve problems of finding and targeting targets.

It was proposed to use the second stage in the form of a streamlined unit with a radio-transparent head part and a passive side-view radar system. Using a folding cross-shaped side-view antenna, it was proposed to search for signals from radio-electronic systems, and final guidance was carried out using a passive radar seeker. It was also proposed to use rather complex control equipment with gyroscopic devices, etc.

Early work on the R-27K project led to the formation of a range of main problems that needed to be solved to create the rocket. First of all, it was determined that the second stage of the rocket from the guidance system is too large. It can occupy up to 40% of the dimensions of the entire rocket, which would require reducing the size of the first stage and reducing the volume of its tanks. In this case, the flight range was expected to be significantly lower than expected. In addition, the second stage guidance systems required a heat-resistant fairing capable of transmitting radio signals.The required materials with such characteristics were not available at that time, and their creation required time and additional research.

Standard version R-27 missile on a transport trolley. Photo Rbase.new-factoria.ru
Probably, it was the lack of ready-made developments for the manufacture of a radio-transparent fairing that led to the fact that in 1963 SKB-385 developed two versions of the R-27K missile with different versions of guidance systems. Both pre-design designs used a unified first stage based on the R-27 units. The stage received a shortened body with tanks for fuel and oxidizer, and should also be equipped with a liquid engine, unified with the R-27. The second stage should be installed on top of the first stage, having its own control systems, engine, etc.

The early Project A variant, proposed in 1963, involved ballistic and aerodynamic flight control. After dropping the first stage, the missile, using a side-view antenna, was able to receive signals from target ship and determine its location.Then a ballistic course correction was made, for which short-

term engine activations of the second stage were used. With the help of one or two engine activations (the fuel supply was limited), the second stage should be able to reach the required trajectory.

Having passed the upper part of the ballistic trajectory, the missile must pass through passive radar homing, find the target and fly towards it. For control in the atmosphere it was proposed to use aerodynamic rudders. This version of two-stage ballistic aerodynamic guidance allows for high hit accuracy and makes it possible to use a powerful warhead.

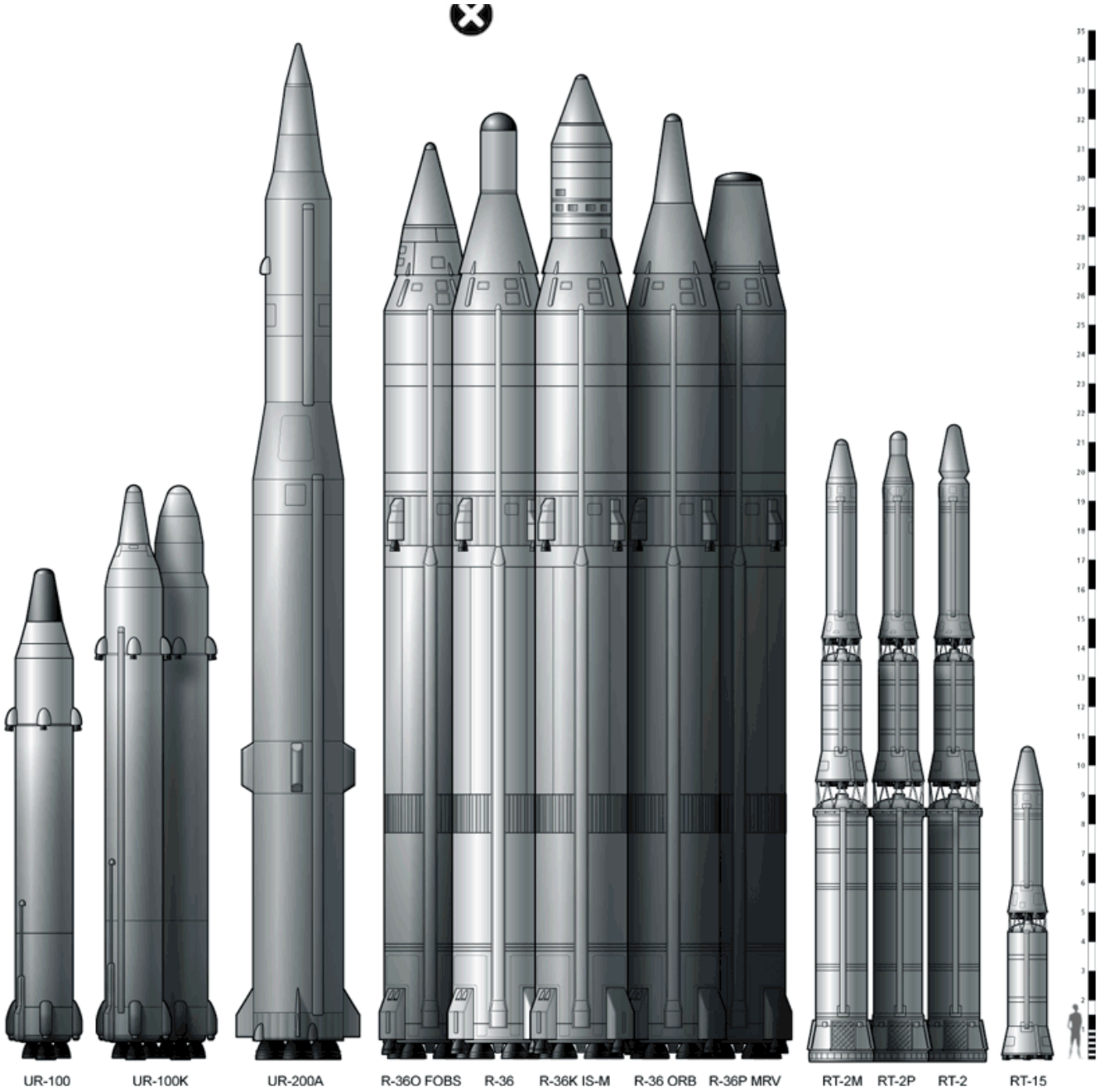
Option "B" suggested the use of ballistic course correction only. For the calculated flight segment, the missile must find the target using a side-view antenna, require the desired trajectory and enter it. After re-entry, no course correction was provided. Ballistic guidance reduced accuracy and required a more powerful warhead.Moreover, such a guidance system was simple and did not require reducing the dimensions of the first stage beyond the permissible limits, allowing the required launch range to be achieved.

Option “A” of the preliminary design. Drawing Otvaga2004.ru
After analyzing two preliminary projects, it was decided to abandon the two-stage guidance. The implementation of ballistic and aerodynamic course correction was associated with a lot of problems and could not be fully implemented. For this reason, project “A” was abandoned, and the development of option “B” continued. It was proposed to determine the target using a passive side-view radar system. The second seeker for searching for targets in the downward section was abandoned.

NII-592 was involved in the creation of a guidance system for the 4K18 product. The finished control system was based on a semiconductor element base and was supposed to solve the problem of finding a target with the subsequent calculation of the flight path to it. The general features of the work were determined in accordance with the preliminary design.At the same time, some new solutions were proposed. To search for targets, it is proposed to use a passive radar GSK with a cross-shaped receiving antenna. During transportation and during the initial phase of the flight, the antenna must be located in the cylindrical compartment of the second stage body. After entering the trajectory correction section, the missile must extend and unfold the antenna to search for target signals.

Having found the target and calculated the optimal trajectory to hit it, the second stage of the rocket had to adjust its course with the existing engine. The reserve allowed the fuel to start the engine twice. After course correction and braking, the second stage should move to the descending section of the trajectory and follow the target.

The finished project of the R-27K missile involved the construction of a two-stage product based on the units of a variant of the R-27 missile. The anti-ship missile was about 9 m long and 1.5 m in diameter.



The launch weight was 13.25 m. The new missile had a characteristic appearance.It received a head part of a complex shape formed by conical and cylindrical surfaces. The complex head fairing was longer in comparison with the units of the R-27 rocket.

Option "B" of the preliminary design. Drawing Otvaga2004.ru

The first stage, reduced in length, with a reduced supply of fuel and oxidizer, was equipped with a 4D10 liquid engine developed at OKB-2. The engine included a propulsion unit with a thrust of 23 tons and a steering system of two separate chambers with a total thrust of 3 tons. The engine consumed fuel in the form of an asymmetrical dimethylhydrazine and nitrogen tetroxide as an oxidizing agent. A curious feature of the power plant of the R-27 and R-27K missiles was the placement of the engine. For the first time in domestic and foreign practice, to save space, the engine was placed inside the fu tank.

The 4K18 missile can be launched using a standard silo installation of the D-5 complex, a missile for submarines of several projects. Before launch, the silo had to be flooded, and in addition, the tanks had to be pressurized to compensate for the pressure.When leaving the launcher, the rocket must be in the so-called. gas exposure, which reduces the bell's exposure to surrounding water. After rising to the surface, the rocket continued to fly towards the target using guidance systems.

The reduction of the first stage of fuel tanks led to a significant reduction in flight range compared to the current missile. The R-27 for ground targets could fly at a range of up to 2500 km, while the anti-ship R-27K was capable of attacking targets from only 900 km.

It was proposed to hit the target using a monoblock warhead with a power of 650 kt. Such a nuclear warhead makes it possible to compensate for the effective destruction of surface ships.

Comparison of R-27K (left) and R-27 (right) missiles. Drawing by Shirokorad A.B. “Weapons of the domestic fleet. 1945-2000"

For initial target designation, it was proposed to use promising systems for detecting surface objects. During the development of the R-27K project, the “Success” system was in service, based on reconnaissance aircraft.For planning purposes, the Legend system with radar reconnaissance

spacecraft was put into operation. The emergence of the last opportunity to use 4K18 missiles with

maximum efficiency.

The main mandatory requirement of SKB-385 was the development of the basic R-27 project. Because of this, the anti-ship weapon project was created with a significant lag behind it. As a result of this lag, the D-5 missile system with the R-27 missile was put into service in 1968, and testing of the 4K18 missile began only in 1970. One of the reasons for this lag was difficulties with the development of certain elements of an anti-ship missile.

In December 1970, the first test launch of the R-27K missile took place at the Kapustin Yar test site. In these tests, a stationary ground stand was used. Over the course of several months, 20 launches were carried out. 16 launches were counted, while the rest ended in failure. Soon, several throw launches were carried out using a submersible stand. During such checks, the entry of the product from the launcher of a submarine located in an underwater position was practiced.

Since the mid-sixties, the issue of choosing a submarine to carry new anti-ship ballistic missiles has been resolved. The D-5 complex with the R-27K missile was proposed to be used with several ty[illegible] submarines. However, only projects 667A, 687 and 705B progressed beyond preliminary work. S[illegible] submarines were supposed to carry from 4 to 16 missiles of a new type. Later, problems arose during

the development of all projects. Thus, the 6[illegible] nuclear submarines delivered to the series should now only be of design in the strategic nuclear forces, and their use as 4K18 carriers was considered incomplete and unacceptable from the point of view of strike potential. Projects 687 and 705B, in turn, encountered numerous technical problems. As a result, three projects were never implemented.

Diesel-electric submarine project 629/605. Figure Wikimedia Commons

By the beginning of the seventies, the issue of the carrier of new missiles had not been resolved, but tests with launches from a submarine were approaching. Because of this, it was decided to involve one of the submarines in testing.The diesel-electric submarine K-102 of Project 629 was chosen as an

experimental vessel for testing a new type of missile. It was proposed to refit it according to the new Project 605, which proposed the installation of four launch silos and a number of other equipment. In particular, the navigation complex and target designation system were updated.

On December 9, 1972, the K-102 submarine launched the R-27K missile for the first time. In about a year of testing, 11 missiles were used up, which were used for various purposes. Of particular interest is the last launch, which took place on November 3, 1973. This time, two 4K18 missiles were launched at a target in the form of a barge with a radar station. One of the fired missiles successfully aimed at the target and hit it with a direct hit. The second came out in the target area with an acceptable deviation from it. It is noteworthy that by the time the missile launched, the uncertainty in the target position reached 75 km. Despite this, the passive homing system detected the target and destroyed it.In general, the tests were successful. 10 out of 11 launches were considered successful.

On September 2, 1975, after completion of a[illegible]sign and test work, a decree was issued to close the R-27K project. Such weapons are of particular interest to the navy, but there were a number of characteristic shortcomings that hampered their operation. Thus, the nuclear warhead made it difficult to deploy submarines with new types of missiles in the light of the new SALT II treaty. The passive radar guidance system of the guidance system of the guidance system, which provides high precision control, acts to counteract it. To trigger the spacecraft, it was enough just to turn off the radar equipment. Finally, by the mid-seventies, significant advances had been made in the field of anti-ship cruise missiles.

A number of reasons made the new R-27K project useless and unpromising. Because of this, all work on the new missile was stopped. As a result, the Navy did not use new unusual weapons and continued to use the power system of a more familiar appearance.At the same time, however, the K-102

boat with the D-5 complex remained in trial operation until the early eighties.

The first domestic project of an anti-ship ballistic missile ended in the successful solution of all the assigned tasks, but was not brought to operational use by the troops. The reason for this was some problems of the project, including those that were fundamentally irreparable. Additional Soviet specialists made another attempt to create similar weapons. A new anti-ship ballistic missile w[illegible] created, the R-33 type, based on the design of the R-29 missile.

Based on materials from:

http://makeyev.ru/

http://otvaga2004.ru/

http://alternathistory.com/

http://rbase.new-factoria.ru/

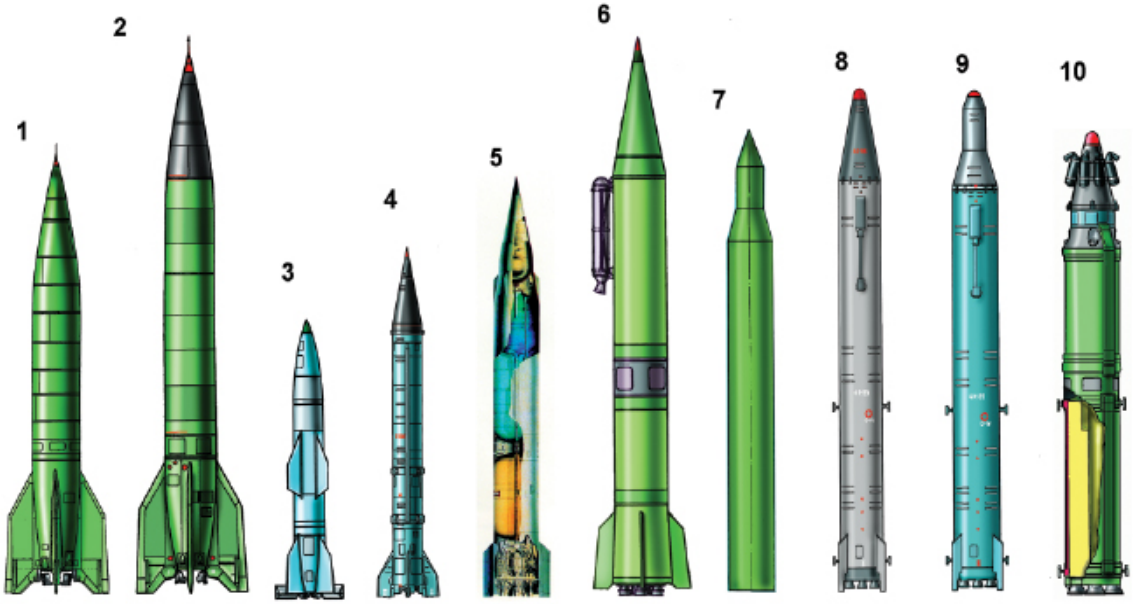
http: // deepstorm.ru/

Shirokorad A. B. Weapons of the domestic fleet. 1945-2000 - Mn.: “Harvest”, 2001.

A message from the depths. How the deadliest submarine weapon works

https://ria.ru/20191020/1559926828.html

A message from the depths.How the deadliest submarine weapon works



Морские баллистические ракеты первого поколения:
1-БРДД Р-1; 2-БРДД Р-2; 3-БРДД Р-101; 4-БРПЛ Р-11ФМ; 5-БРПЛ Р-13; 6-БРПЛ Р-15; 7-БРПЛ Р-13М; 8-БРПЛ Р-21; 9-БРПЛ Р-21 (Мод.); 10=БРПЛ Д-6

A message from the depths. How the deadliest submarine weapon works

Stealthy, powerful, long-range - submarine-launched ballistic missiles (SLBMs) remain the main striking force of the fleets of nuclear powers. In the United States, more than half of all ... RIA Novosti, 10.20.2019

2019-10-20T08:00

2019-10-20T08:00

2019-10-20T08:06

Dmitry Donskoy

Alexander Nevskiy

Project 955 Borey submarines

safety

/html/head/meta [@name='og:title']/@content

/html/head/meta [@name='og:description']/@content

https://cdn22.img.ria.ru/images/155794/01/1557940120_0:52:1000:615_1920x0_80_0_0_2df2947c31b84e4573

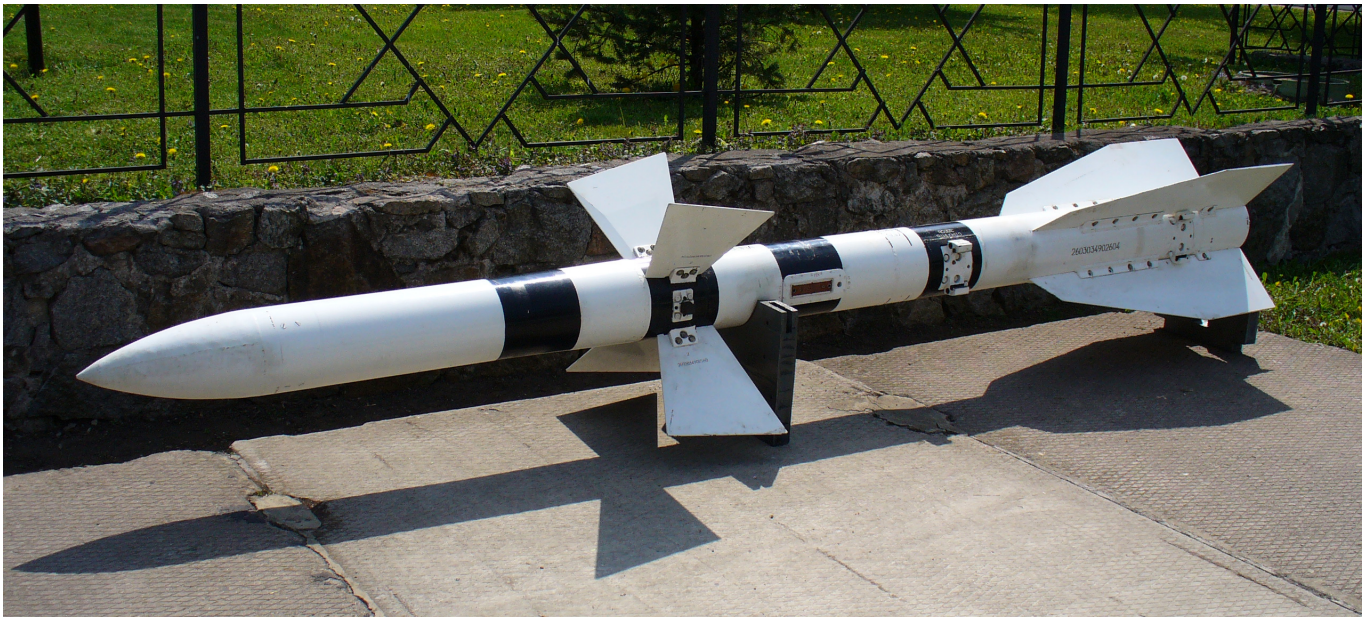
MOSCOW, October 20 - RIA Novosti, Andrey Kots. Stealthy, powerful, long-range - submarine-launched ballistic missiles (SLBMs) remain the main striking force of the fleets of nuclear powers. In the United States, more than half of all strategic warheads are deployed on nuclear submarines.Russia relies

mainly on “land-based” intercontinental missiles, but it is also in no hurry to write off SLBMs. Read about how this type of weapon developed and why it is the future in the RIA Novosti article. First launch The idea of deploying ballistic missiles on underwater carriers matured in the minds of gunsmiths by the mid-50s. The USSR and the USA hastily used new means of delivering nuclear

weapons. By that time, serial intercontinental missiles had not yet been produced, but both sides had accumulated considerable experience in the construction of medium-range missiles. The new concept envisages their creation on the basis of submarines that covertly approach coastal troubles and fire a devastating salvo. In the fall of 1954, the first naval missile R-11FM, a modification of the “land” R-11, was launched from the Kapustin Yarky test site. A year later, the finalized SLBM for the first time in history was launched from the B-67 submarine. She flew only 250 kilometers, but this was enough to understand: nuclear weapons on submarines have a great future.The USSR acquired new capabilities for launching attacks on the territory of Europe and the United States. We have one significant drawback. Boats could only fire them from the surface. In addition, a lot of time was spent preparing for the start. This made strategic submarines easy targets for aircraft and surface ships. The first Soviet submarine-launched missile was the R-21, which entered service in 1963. At that time it was a real breakthrough. The system has a range of 1,300 kilometers when equipped with a one-megaton warhead and 1,600 kilometers with an 800-kiloton warhead. Inertial control system improved improved performance coefficient of probable deviation of 2.8 kilometers. “Wet” versus “dry”, despite decent characteristics, the R-21 was significantly inferior to the American missiles “Polaris-A1” (range 2200 kilometers) and “Polaris-A2” (2800 kilometers), the main advantage of the rocket was the ability to launch from a depth of 40 meters.).New media was required to remove the backlog. A few years

later, the USSR tested the R-27, capable of throwing a megaton nuclear charge over a distance of up to 3,000 kilometers. The launch was carried out through the so-called “wet launch”. At the bottom of the R-27 there was a special adapter with which it was docked with the launch pad. During prepara the tanks were pressurized, water entered the shaft, and the pressure was equalized with the outboard

pressure. Then the lid was opened and the main engine was turned on. All domestic liquid SLBMs were distinguished by “wet start”. However, this method has disadvantages. Filling the shafts with water takes time and creates acoustic noise. If a submarine is being pursued by an anti-submarine ship, it is able to quickly take direction and destroy it. Solid propellant rockets are good because they can perform a “dry launch”. They are fired from a shaft with a powder charge, and the engine is turned on above the surface of the water. This method is quieter and faster, thanks to which the chances of a successful launch increase dramatically.To the solid-fuel Soviet SLBMs R-31 with a range of up to 4200 kilometers and R-39 (8250 kilometers), as well as the newest R-30 Bulava (9300 kilometers). types of ballistic missiles. Firstly, these are the liquid-fuelled two-stage R-29, which has the last remaining Project 667BDR Kalmar boat in service - the K-44 Ryazan. These missiles can throw three warheads of 200 kilotons each over a range of 6,500 kilometers. Secondly, the Navy’s arsenal remains the family of liquid-propelled three-stage missiles R-29RM. They are armed with six “strategists” of Project 667BDRM “Dolphin” - K-51 “Verkhoturye”, K-84 “Ekaterinburg”, K-114 “Tula, K- 18 "Karelia", K-407 "Novomoskovsk" and K-117 "Bryansk" being repaired. Each boat has 16 mines. The R-29R entered service more than 30 years ago and has been modernized several times. The latest modification, Sineva, flies 11,550 kilometers. with a capacity of 100 kilotons each or four warheads of 500 kilotons with missile defense penetration equipment. Finally, the most modern strategic nuclear-powered ships - three boats of Project 955 "Borey" - K-535 "Yuri Dolgoruky", K-550 "Alexander Nevsky" and K-551 " Vladimir Monomakh" - armed with R-30 "Bulava" solid-fuel ballistic missiles.In addition, the heavy



submarine cruiser Dmitry Donskoy, the last representative of Project 941, was converted to use this SLBM. It carries 20 missiles, Borei - 16 each. Bulava was put into operation in 2018 after 15 years of testing. “delivers six individually targeted warheads of 150 kilotons each. The probable deviation coefficient is not higher than 350 meters. The advantages of the new SLBM include a short booster active section. It is believed that it is the non-metals that are most vulnerable to missile defense systems. In addition, the Bulava can maneuver during acceleration, protecting it from kinetic interceptors designed for conventional ballistic trajectories.

https://ria.ru/20191001/1559289386.html

https://radiosputnik.ria.ru/20191017/1559899387.html

https: // ria.ru / 201

/1557861229.html

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn--c1acbl2abdlkab1og.xn/awards/

2019

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https: //xn--c1acbl2abdlkab1og.xn--p1ai/ awards /

News

ru-RU

https://ria.ru/docs/about/copyright.html

https: //xn--c1acbl2abdlkab1og.xn--p1ai/

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https: //xn--c1acbl2abdlkab1og.xn--p1ai/awards/

https://cdn22.img.ria.ru/images/155794/01/1557940120_57:0:945:666_1920x0_80_0_0_a148000e4000e4000e

RIA Novosti

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https://xn - c1acbl2abdlkab1og.xn - p1ai / awards /

RIA News

internet-group@rian.ru

7 495 645-6601

FSUE MIA "Russia Today"

https: //xn--c1acbl2abdlkab1og.xn--p1ai / awards /

Dmitry Donskoy, Alexander Nevsky, Project 955 Borei submarines, security

MOSCOW, October 20 - RIA Novosti, Andrey Kots. Stealthy, large, long-range - submarine-launched ballistic missiles (SLBMs) are a powerful striking force for the fleets of nuclear powers. In the United States, more than half of all strategic warheads are deployed on nuclear submarines. Russia relies mainly on “land-based” intercontinental missiles, but it is also in no hurry to write off SLBMs. Read about how this type of weapon developed and why it is the future in the RIA Novosti article.

First launch

The idea of deploying ballistic missiles on underwater carriers matured in the minds of Soviet gunsmiths by the mid-50s. The USSR and the USA hastily used new means of delivering nuclear weapons. By that time they had not yet produced serial intercontinental missiles, but both sides had accumulated considerable experience in the construction of medium-range missiles. The new concept involves the creation of submarines that secretly approach the enemy’s coast and fire a crushing

October 1, 2019, 08:00

Father of the apocalypse. The most large-scale projects of the Soviet designer Kozlov

In the fall of 1954, the first naval missile R-11FM, a modification of the “land” R-11, was launched from the Kapustin Yarky test site.A year later, the completed SLBM was launched for the first time in history

from the B-67 submarine. She flew only 250 kilometers, but this was enough to understand: nuclear weapons on submarines have a great future. The USSR acquired new capabilities for launching attacks on the territory of Europe and the United States.

Early SLBMs, both Soviet and American, had one significant drawback. Boats could only fire them from the surface. In addition, a lot of time was spent preparing for launch. This made strategic submarines easy targets for aircraft and surface ships.

The first Soviet submarine-launched missile was the R-21, which entered service in 1963. At that time it was a real breakthrough. The system has a range of 1,300 kilometers when equipped with a one-megaton warhead and 1,600 kilometers with an 800-kiloton warhead. Inertial control system improved improved performance coefficient of probable deviation of 2.8 kilometers.However, the main advantage of the rocket was the ability to launch from a depth of 40 meters.

"Wet" versus "dry"

Despite its decent characteristics, the R-21 was significantly inferior to the American Polaris-A1 (range 2,200 kilometers) and Polaris-A2 (2,800 kilometers) missiles. New media was required to remove the backlog. A few years later, the USSR tested the R-27, capable of throwing a megaton nuclear cha a distance of up to 3,000 kilometers.

17 October 2019, 15:09

Launches of ballistic and cruise missiles took place at the Grom-2019 exercises

The launch was carried out through the so-called “wet start.” At the bottom of the R-27 there was a special adapter with which it was connected to the launch pad. During preparation, the tanks were pressurized, water entered the shaft, and the pressure was equalized with the outboard pressure. Then the lid opened and the main engine turned on.

All domestic liquid-propellant SLBMs were distinguished by “wet launch”. However, this method has disadvantages.Filling the shafts with water takes time and creates acoustic noise. If a submarine is

being pursued by an anti-submarine ship, it is able to quickly take direction and destroy it.

Solid propellant rockets are good for those that can perform a “dry launch”. They are fired from a shaft with a powder charge, and the engine is turned on above the surface of the water. This method is quieter and faster, thanks to which the chances of a successful launch increase dramatically. To the solid-fuel Soviet SLBMs R-31 with a range of up to 4200 kilometers and R-39 (8250 kilometers), as well as the newest R-30 Bulava (9300 kilometers).

For "Dolphins" and "Boreys"

Today, Russian nuclear-powered ships use several types of ballistic missiles.

Firstly, these are the liquid-fuelled two-stage R-29R, which is armed with the last remaining Pro 667BDR Kalmar boat in service - the K-44 Ryazan. These missiles can throw three warheads of 200

kilotons each over a range of 6,500 kilomet

Secondly, the R-29RM family of liquid-propellant three-stage missiles remains in the Navy's arsenal. They are armed with six “strategists” of project 667BDRM “Dolphin” - K-51 “Verkhoturye”, K-84 “Ekaterinburg”, K-114 “Tula”, K-18 “Karelia”, K-407 “Novomoskovsk” and the K -117 "Bryansk". Each boat has 16 mines.

The R-29RM was put into service more than 30 years ago and modernized several times. The latest modification, Sineva, flies 11,550 kilometers. Warhead - up to ten individual targeting units with a capacity of 100 kilotons each or four warheads of 500 kilotons with missile defense penetration equipment.

Finally, the most modern strategic nuclear-powered ships - three boats of Project 955 "Borey" - K-535 "Yuri Dolgoruky", K-550 "Alexander Nevsky" and K-551 "Vladimir Monomakh" - are armed with R-30 "Bulava" solid-fuel ballistic missiles. In addition, the heavy submarine cruiser Dmitry Donskoy, the last representative of Project 941, was converted to use this SLBM. It carries 20 missiles, Borei - 16 each. Bulava was commissioned in 2018 after 15 years of testing.

The Bulava delivers six individually targeted warheads of 150 kilotons each.The probable deviation coefficient is not higher than 350 meters.

24 August 2019, 13:44

A video of the Bulava launch from the Yuri Dolgoruky submarine has been published.
The advantages of the new SLBM include a short booster active section. It is believed that it is the non-launchers that are most vulnerable to missile defense systems. In addition, the Bulava can maneuver during acceleration, protecting it from kinetic interceptors designed for conventional ballistic trajectories.

BALLISTIC MISSILES OF SUBMARINES. Domestic missile weapons

SUBMARINE BALLISTIC MISSILES

R -1 (MARINE OPTION)

In 1949, at TsKB-18, under the leadership of chief designer F.A. Kaverin, the P-2 submarine project was developed, which, according to the designers, should carry 12 launchers of land-based ballistic li missiles R-1, designed by chief designer Sergei Korolev, and also cruise missiles. Special tanks f storing liquid oxygen and an installation for producing liquid oxygen were created on the boat.The

launch had to be made from a surface posi[illegible]. Due to technical difficulties, the project was not implemented. Work stopped in 1950.

R-11FM

D-1. R-11FM. 8A61FM

The D-1 missile system with a surface-launched ballistic missile for submarines. The missile was created on the basis of the ground tactical R-11. Development began on January 26, 1954 at OKB-1 under the leadership of Sergei Korolev. In August 1955, development was continued and completed at OKB-385 (has the Miass Mechanical Engineering Design Bureau) under the leadership of Viktor Makeev. Flight design tests took place from 1955 to 1958, first on a fixed stand, then on a rocking stand at the Kapustin Yar test site, then on a submarine in the White Sea. In September 1955, the re-equipment of the B-67 submarine according to the B-611 project was completed, during which the submarine placed two missile launchers. The world's first launch of a ballistic missile from a submarine on the surface took place on September 16, 1955.Adopted

Diesel-electric submarine of project AV-611 (Zulu V) February 20, 1959, later - diesel-electric submarine of project 629 (Golf I) with three launchers on board. Serial production of missiles began in 1956 at the Zlatoust Machine-Building Plant. Serial production of five diesel-electric submarines of the AB-611 project began in 1955. A single-stage surface-launched missile with a liquid-propellant rocket engine using stored high-boiling fuel. The control system is inertial. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Flight control was carried out using gas-jet rudders, stabilization - using aerodynamic stabilizers. Shooting was carried out from the upper section of the submarine's shaft. Fueling a rocket with nitric acid immediately before firing. The propulsion engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev. The launcher was developed under the leadership of Evgeny Rudyak. The maximum firing range of a missile equipped with a nuclear warhead is 150 km. The maximum firing range of a missile with a lightweight non-nuclear warhead is 250 km. Launch weight is 5.46 tons. Rocket length is 10.3 m. Maximum body diameter is 0.88 m. Payload weight is 0.98 tons. The power of a monoblock warhead is nuclear warhead. — 10 kt. The D-1 complex was withdrawn from service in 1967.

Launch of R-11FM

R-13

D-2.R-13. 4K50 [SS-N-4. SARK]

The D-2 missile system with a surface-launched ballistic missile for submarines. The first domestic complex created specifically for submarines. Work on the preliminary design began on August 25, 1955 at OKB-1 under the leadership of Sergei Korolev. The tactical and technical specifications for the D-2 complex were approved on January 11, 1956. In 1956, the development was transferred to the Miass mechanical engineering design bureau (chief designer - Viktor Makeev). For the D-2 complex, under the leadership of the chief designer of KB-1 TsKB-34, Evgeniy Rudyak, the SM-60 bolt installation for launching R-11FM and R-13 missiles with diesel-electric submarines in the surface position.The installation was also put into service for the first nuclear submarines with R-13 missiles. Flight design tests took place from December 1958 to 1960, first at the Kapustin Yar training ground, then at the White Sea. Tests on the submarine were carried out from November 1959 to August 1960. The diesel-electric submarine of Project 629 (Golf I) was put into service in 1960, and later the nuclear submarine of Project 658 (Hotel I) with three launchers on board. Serial production of missiles was launched at the Zlatoust Machine-Building Plant in 1959. A single-stage surface-launched missile with a liquid-propellant rocket engine using stored high-boiling fuel.

The control system is inertial. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The missile is designed to be fired from the top of a submarine silo. Has a detachable warhead. The design uses self-igniting fuel components, turbopump supply, and in-flight control is carried out by oscillating chambers of the steering rocket engine. Fueling a rocket with nitric acid immediately before firing.The main engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vladimir Petrov.

The maximum firing range is 560 km. Launch weight - 13.6 tons. Rocket length - 11.8 m. Maximum body diameter - 1.3 m. Payload weight - 1.6 tons. Nuclear warhead power of a monoblock warhead - 1 Mt. The missile's shelf life in combat readiness is 3-6 months. The guaranteed shelf life of the rocket is 5-7 years. Based on the R-13, a project for an aviation anti-ship missile was developed to arm strategic bombers. In 1960, development was stopped. On October 20, 1961, the R-13 rocket was launched, followed by a nuclear explosion at the Novaya Zemlya test site. This is the first and only test launch of a submarine-launched ballistic missile with a nuclear explosion in the country's history.

In 1963-1967 seven eight built Project 658 submarines with D-2 missile systems were converted into Project 658M submarines with D-4 missile systems.In 1969, the conversion of the last, eighth submarine Project 658 with the D-2 missile system into the submarine Project 701 for testing R-29 missiles began.

By 1979, all Project 629 submarines with D-2 missile systems were withdrawn from the fleet.

D-4. R-21. (OPTION 1). 4K55 [SS-N-5. SERB]

The D-4 complex with the R-21 missile for the underwater launch of a missile on a main engine from a flooded submarine silo. The first domestic marine underwater launch complex. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began on May 13, 1959 (the development of this complex was entrusted to the Yuzhnoye design bureau on December 3, 1958, but on May 13, 1959, the decision of the Southern Government design bureau was taken away from the development of missiles for the Navy). Preliminary tests of the possibility of underwater launch were carried out using a modified R-11FM rocket in 1956-1960. Flight design tests of the R-21 missile took place from 1960 to 1962. The first missile launch from the underwater position of a diesel-electric submarine was carried out on February 24, 1962. A total of 27 missile launches were carried out during the tests.The diesel-electric submarine of Project 629B was used for testing. The complex of adopted weapons of the diesel-electric submarine of Project 629A (Golf II) and the nuclear submarine of Project 658M (Hotel II) with three launchers on board in two versions in 1963. Serial production was launched at the Zlatoust Machine-Building Plant. The SM-87 launch facility is introduced under the leadership of chief designer Evgeniy Rudyak. After being put into service, the old SM-60 installations were replaced on submarines with new ones - SM-87. A single-stage underwater launch rocket with a liquid-propellant rocket engine using stored high-boiling fuel. The control system is inertial. The budget management system in the Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The propulsion engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vladimir Petrov.

Launcher of the installation in TsKB-34 under the leadership of Evgeniy Rudyak. The first option had a maximum firing range of 1,420 km.Launch weight - 16.6 tons. Weight of warhead - 1.2 tons. Rocket length - 14.2 m. Maximum body diameter - 1.3 m. Nuclear warhead power of a monoblock warhead - 1 Mt. The shooting was carried out from a shaft created by water (the so-called “wet start”) with a depth of 40–50 m, with sea waves up to 5 points and a submarine speed of up to 4 knots. During operation, the storage life of the fueled rocket was increased from 6 months to 2 years.

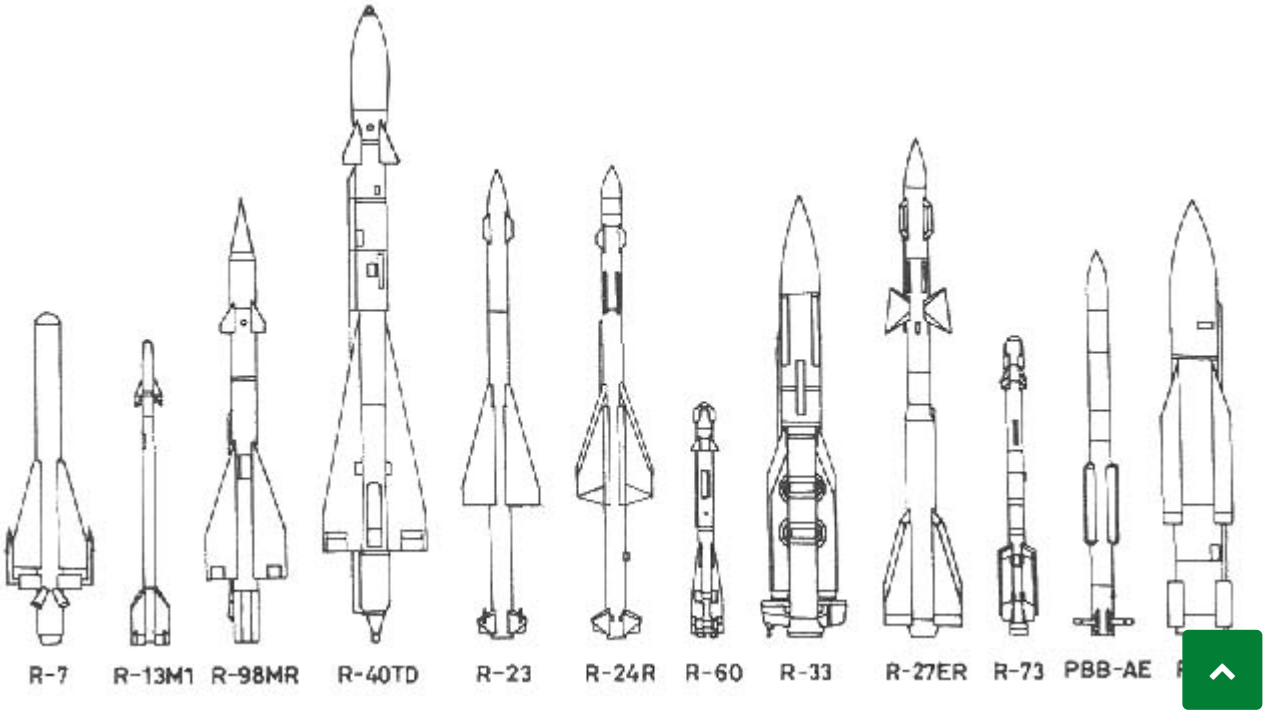
Project 629A submarines with the D-4 missile system were withdrawn from the fleet in 1990.

Project 658M submarines with R-21 missiles were withdrawn from the fleet by 1991.

R-21

D-4. R-21 (OPTION 2). 4K55 [SS-N-5. SERB]

Missile system D-4 with an underwater launch ballistic missile for submarines. Option with increased flight range. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began in 1959. Flight design tests took place from 1960 to 1962. The diesel-electric submarine of Project 629A (Golf II) and the nuclear submarine of Project 658M (Hotel II) with three launchers on board were adopted in two versions in 1963Serial production has been launched at the

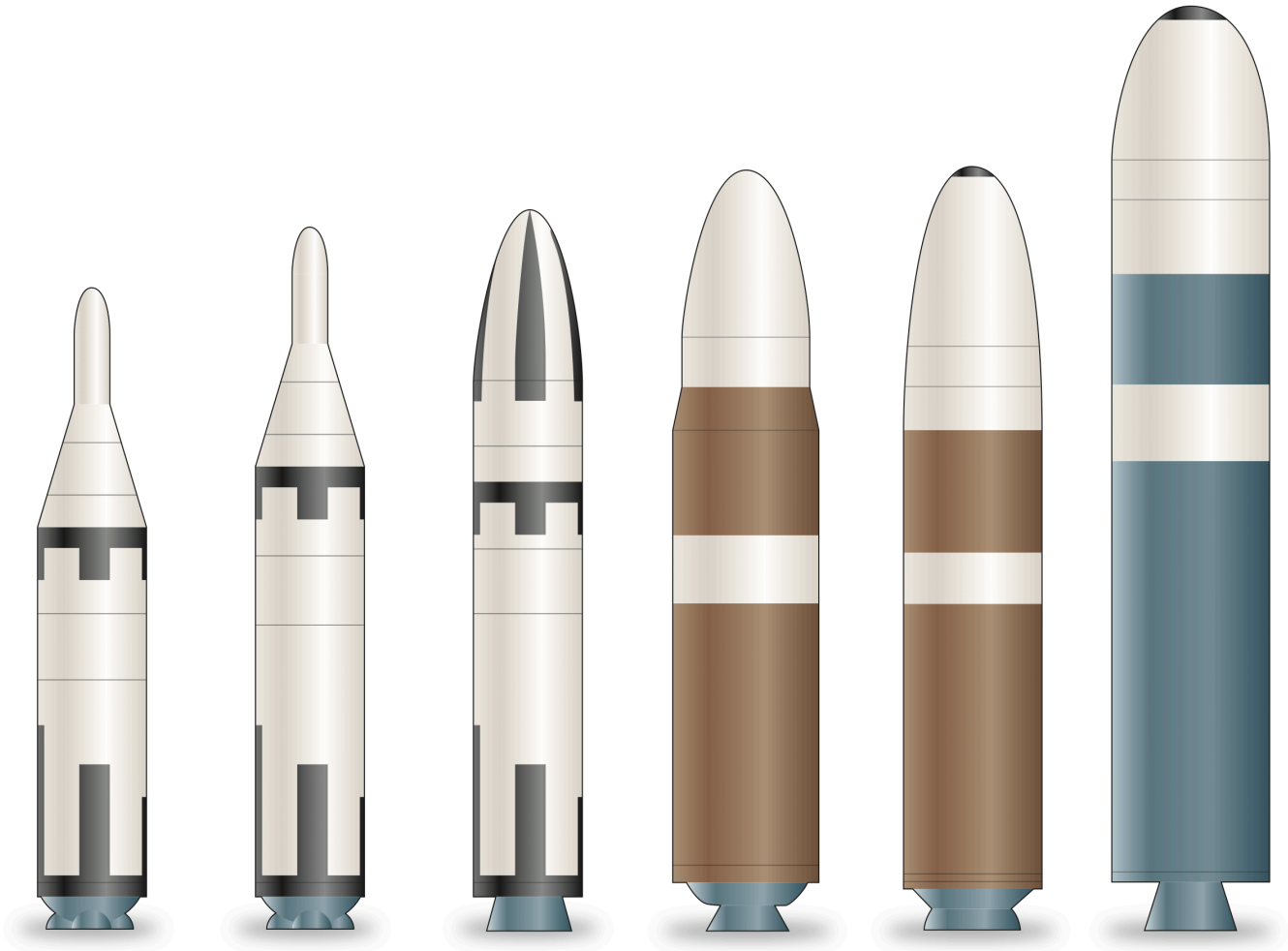


Zlatoust Machine-Building Plant. For the D-4 complex with the R-21 rocket for the underwater launch

of the rocket on the main engine, the budge[illegible]der the leadership of the chief designer Rudyak is the SM-87 launch unit. After being put into service, the old SM-60 installations were replaced on submarines with new ones - SM-87.

A single-stage underwater launch rocket with a liquid-propellant rocket engine using stored high-boiling fuel. The control system is inertial. Budget management system in the Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The propulsion engine was developed in the Chemical Engineering Design Bureau under the leadership

Alexey Isaev. Launcher under the direction of Evgeniy Rudyak. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vladimir Petrov. The maximum firing range is 1600 km. Launch weight - 19.7 tons. Rocket length - 14.2 m. Maximum body diameter - 1.3 m. Nuclear warhead power of a monoblock warhead - 0.8 Mt.The



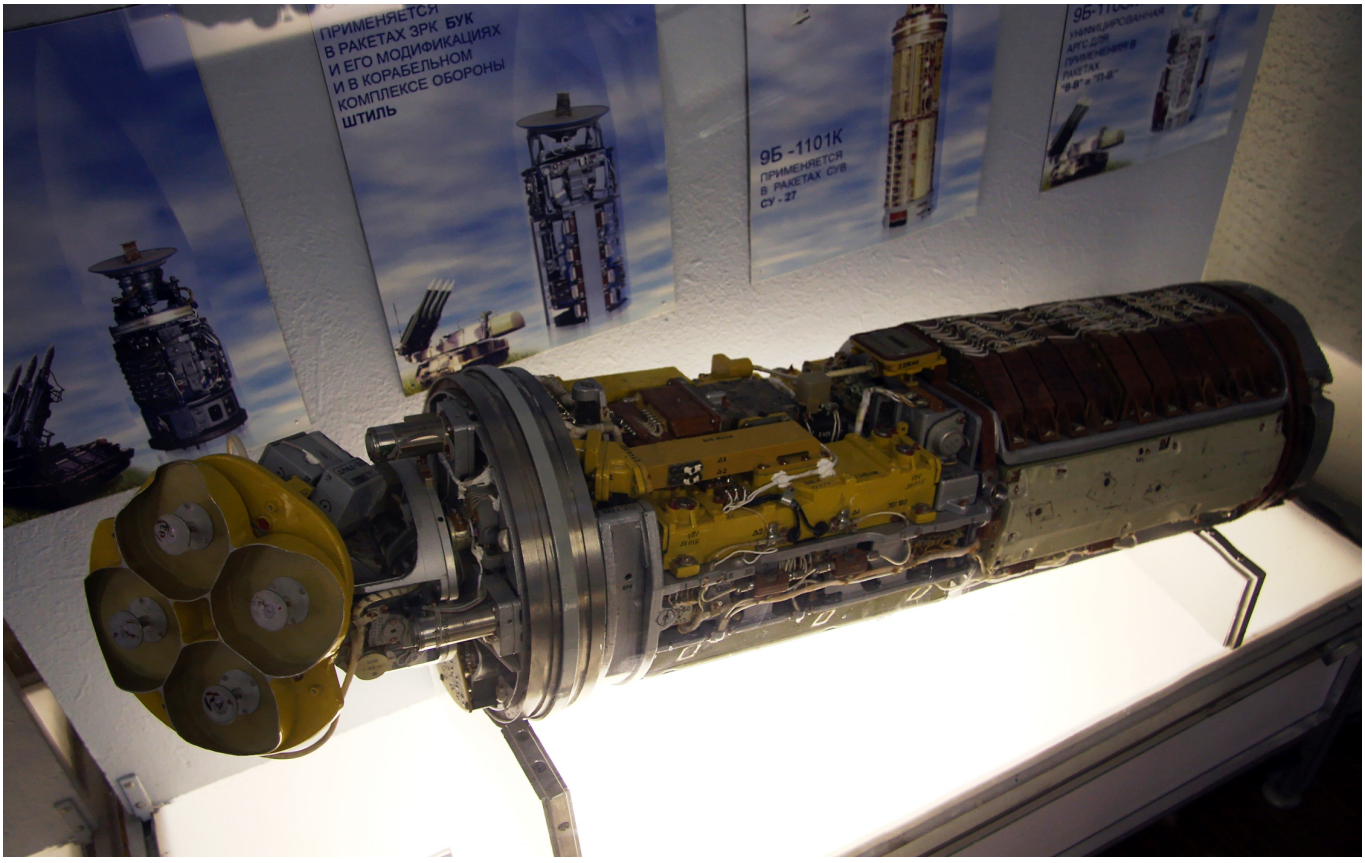
shooting was carried out at a depth of 40-50 m, with sea waves up to 5 points and the speed of the submarine up to 4 knots. Project 629A submarines with the D-4 missile system were withdrawn[illegible] the fleet in 1990.

Project 658M submarines with R-21 missiles were withdrawn from the fleet by 1991.

R-27

D-5. R-27 (RSM-25). 4K10 [SS-N-6. SAWFLY]

Missile system D-5 with an underwater launch ballistic missile for submarines. The first naval medium-range ballistic missile. Development at the Miass Design Bureau of Mechanical Engineering under the leadership of Viktor Makeev began on April 24, 1962. A high-speed nuclear submarine of Project 687 (705B) was developed for the complex at the Malakhit MBM. However, development was stopped. At the same time, MBM Malachite began developing the Project 679 (671B) nuclear submarine. This project was also discontinued. Tests took place in 1966-1967. The first missile launch from a submarine was carried out in August 1967. The adopted weapons complex of the Project 667A nuclear submarine "Navaga" (Yankee I) with sixteen launchers on board on March 13, 1968.The Project 667A

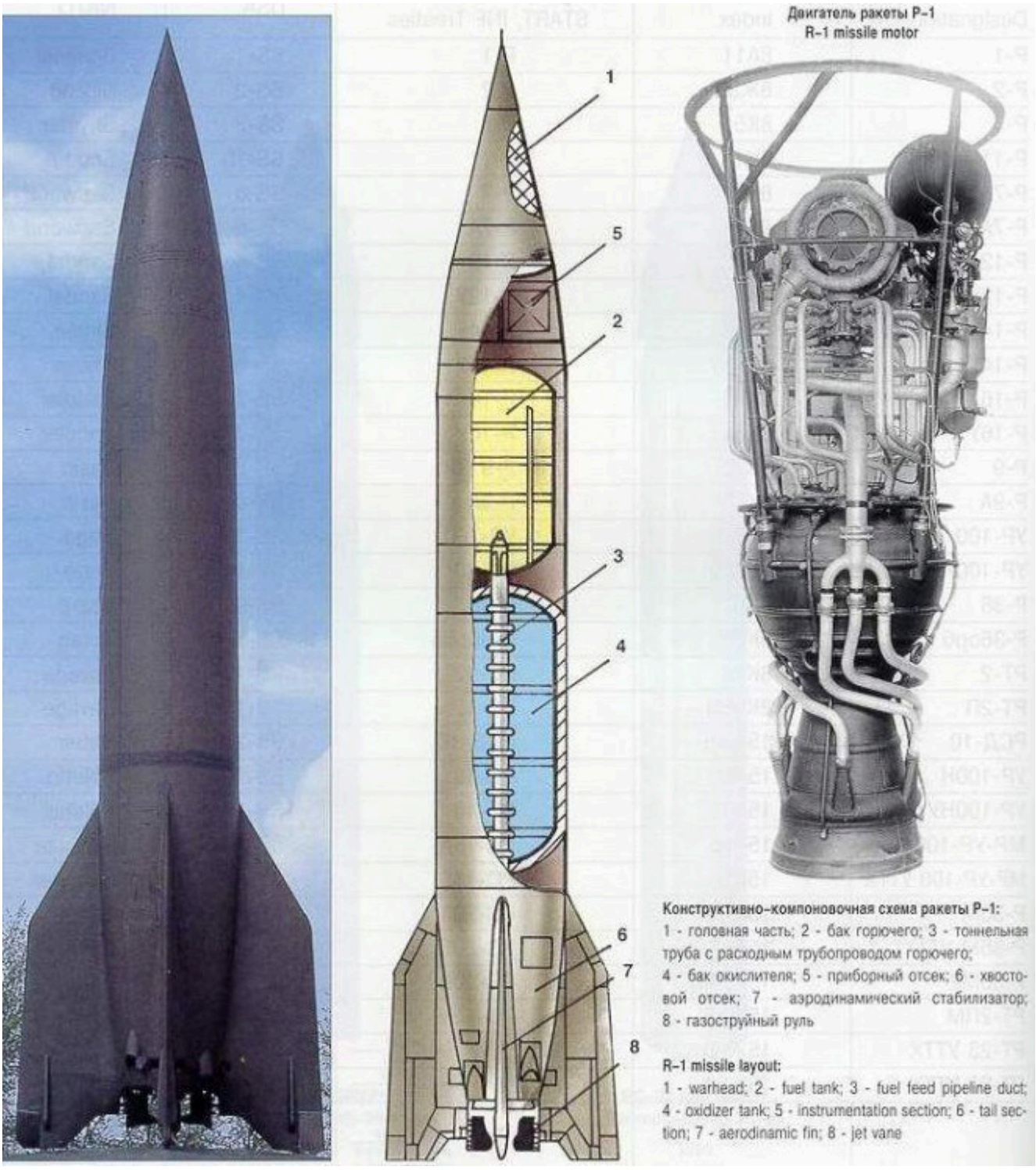


nuclear submarine could fire two salvoes of eight missiles. Serial production of missiles began in 1967 at the Krasnoyarsk Machine-Building Plant.

A single-stage, small-sized underwater launch rocket with a liquid-propellant rocket engine using stored high-boiling fuel (nitrogen tetraxide and dimethylhydrazine). Ampulization took place at the manufacturing plant. Has an inertial control system. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. In the design of the rocket, for the first time, an all-welded body with an engine in an aluminum fuel tank (the so-ca “recessed” design), parts loaded with external pressure, and rubber-metal shock absorbers were used;

elements of the launch structure are located on the rocket itself, control of pre-launch preparation and salvo firing is automated, elements of the control system are located on a gyro-stabilized platform.

The propulsion engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev.Launcher under the direction of Evgeny Rudyak. The ground equipment



complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov. The maximum firing range is 2400 km. Launch weight - 14.2 tons. Maximum throw weight - 0.65 tons. Rocket length - 9 m. Maximum body diameter - 1.5 m. Nuclear warhead power of a monoblock warhead - 1 Mt. Firing is carried out from the initial flooded silo from a depth of 40 -50 m, with sea state up to 5 points and submarine speed of 4 knots. In 1969, for the first time,

continuous patrols in the Atlantic Ocean be[illegible] for Soviet Project 667A nuclear submarines with R-27 nuclear missiles on board.

During the operation of the R-27 missiles, various modification periods were increased from five warranty periods to thirteen years. Based on the R-27 SLBM, the Zyb space launch vehicle.

From 1988 to 1994, all submarines of projects 667A and 667AU were withdrawn from service.

D-5U. R-27U (OPTION 1) (RSM-25) [SS-N-6. SAWFLY]

The D-5U missile system with a modernized underwater launch ballistic missile with an increased flight range for submarines.The rocket has an engine with increased thrust and an improved control system. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began on June 10, 1971. Flight tests took place from September 1972 to August 1973. The nuclear submarines of project 667A and 667AU Navaga (Yankee I) with sixteen launchers on board were put into service January 4, 1974 in two versions. The Project 667AU nuclear submarine could fire two salvoes of eight missiles. Serial production has been launched at the Krasnoyarsk Machine-Building Plant. A single-stage underwater launch rocket with a liquid-propellant rocket engine using stored high-boiling fuel. Has an inertial control system. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The propulsion engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev. The launcher was developed under the leadership of Evgeny Rudyak. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov.The maximum firing range is 3000 km. Launch weight - 14.2 tons. Rocket length - 9 m. Maximum body diameter - 1.5 m. Nuclear warhead power of a monoblock warhead - 1 Mt.

From 1988 to 1994, all submarines of projects 667A and 667AU were withdrawn from service.

D-5U. R-27U (OPTION 2) (RSM-25) [SS-N-6.SAWFLY]

The D-5U missile system with an underwater-launched ballistic missile for submarines, for the first time equipped with a multiple cluster warhead. The rocket has an engine with increased thrust and an improved control system. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began on June 10, 1971. Flight tests took place from September 1972 to August 1973. The nuclear submarines of project 667A and 667AU Navaga (Yankee I) with sixteen launchers on board were put into service January 4, 1974 in two versions. The Project 667AU nuclear submarine could fire two salvoes of eight missiles. Serial production has been launched at the Krasnoyarsk Machine-Building Plant. A single-stage underwater launch rocket with a liquid-propellant rocket engine using stored high-boiling fuel.Has an inertial control system.

Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of designer Nikolai Semikhatov. The propulsion engine was developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev. The launcher was developed under the leadership of Evgeny Rudyak. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov. The maximum firing range is 3000 km. Launch weight - 14.2 tons. Rocket length - 9 m. Maximum body diameter - 1.5 m. The MIRV is equipped with three warheads with a nuclear warhead capacity of 0.2 Mt. The warhead does not have a common head fairing. From 1988 to 1994, all submarines of projects 667A and 667AU were withdrawn from service.

D-5. R-27K. 4K18 [SS-NX-13]

D-5 missile system with R-27K ballistic missile for submarines. Development began on April 24, 1962 at the Miass Mechanical Engineering Design Bureau under the leadership of Viktor Makeev. The project involves the use of two missiles: the R-27 for firing at ground targets and the R-27K for firing at ship formations and aircraft carrier strike groups.Serial production has been launched at the Krasnoyarsk Machine-Building Plant. The two-stage ballistic missile R-27K with a monoblock warhead passed flight tests and was put into trial operation in 1974. The missile had target sighting and homing systems and was designed to combat naval strike groups. The launchers with four R-27K missiles were placed on one experimental diesel-electric submarine "K-102" of Project 605, converted from a Project 629 submarine. This is the world's only naval anti-ship complex with a ballistic m e. During the rocket's operation from 1968 to 1988, 492 rocket launches were carried out, of which 429

launches were successful. Launch weight - 13.25 tons. Maximum firing range - 900 km. The length of the rocket is 9 m. The diameter of the body is 1.5 m.

Loading the R-29 missile into the submarine silo

D-9. R-29 (RSM-40). 4K75 [SS-N-8]

The D-9 missile system with an underwater launch ballistic missile for submarines. The first domestic naval intercontinental ballistic missile.For the first time, it is equipped with a set of means to overcome missile defense. Development at the Miass Mechanical Engineering Design Bureau under the leadership of Viktor Makeev began on September 28, 1964. In 1964, at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov, the development of ground-based rocket equipment began. For its flight testing, for the first time, a ground-based launch complex with a ship-based silo program was created at the Navy training ground in Severodvinsk, the first launch from which took place in February 1968. The first stage of flight design tests took place from March 1969 to December 1971. The first launch from The submarine was produced on December 15, 1971. Tests continued in August - November 1972. After 47 test launches, the Project 667B Murena complex (Delta I) with twelve launchers on board on March 12, 1974. Firing is carried out in one salvo. Serial production has been launched at the Krasnoyarsk Machine-Building Plant.

A two-stage ampulized underwater-launched intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel.Has a flight path astro correction system. Budget management system in the Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Suspension engines were developed in the Chemical Engineering Design Bureau under the leadership of Alexey Isaev and V. Bogomolov. The propulsion systems of the first and second stages consisted of single-chamber propulsion rocket engines and two-chamber steering rocket engines with pumping their own chambers. The maximum firing range is 7800 km. Launch weight - 33.3 tons. Rocket length - 13 m. Maximum body diameter - 1.8 m. Payload weight - 1.1 tons. Nuclear warhead power of a monoblock warhead - 1.5 Mt.

On July 3, 1981, the R-29 was launched for the first time in the Arctic after the submarine surfaced from under the ice. The Vysota space launch vehicle was based on the R-29 SLBM.

The withdrawal of the nuclear submarine pr. 667B from the fleet began in 1994.

R-29R

R-29U

D-9D. R-29U (RSM-40) [SS-N-8]

The D-9D missile system with a modernized ballistic missile with an increased underwater launch range for submarines.The missile is equipped with a missile defense penetration system. The complex was developed in the Miass Mechanical Engineering Design Bureau under the leadership of Viktor Makeev. The Project 667BD Murena-M (Delta II) nuclear submarine with sixteen launchers on b

was put into service in 1978. Firing is carried out in two salvoes of twelve missiles and four missiles. Serial production has been launched at the Krasnoyarsk Machine-Building Plant.

A two-stage underwater-launched intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel. Equipped with a flight path astro correction system. Budget management system in the Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Suspension engines were developed in the Chemical Engineering Design Bureau under the leadership of Alexey Isaev and V. Bogomolov.

The maximum firing range is 9100 km. Launch weight - 33.3 tons. Rocket length - 13 m. Maximum body diameter - 1.8 m. Payload weight - 1.1 tons. Nuclear warhead power of a monoblock warhead - 0.8 Mt.In 1996, the first nuclear submarine, Project 667B, was withdrawn from the fleet and liquidated.

Preparation and loading of the R-29R missile for testing from a ground launcher

D-9R.R-29R (RSM-50). 3M40 [SS-N-18. STINGRAY]

The D-9R missile system with an underwater-launched intercontinental ballistic missile for submarines. Development at the Miass Design Bureau of Mechanical Engineering under the leadership of Viktor Makeev began in 1973. In the same year, at the Moscow Design Bureau of Transport Engineering under the leadership of Vsevolod Solovyov, the development of a ground-based launch complex for testing and a complex of ground-based missile equipment began, and later a sealed missile container 3F40K was developed. Totally ground-based The launch complex provided preparation and launch of 46 missiles. Flight design tests took place from 1976 to 1977. 22 missiles were launched during the LKI. The adopted weapons complex of the Project 667BDR nuclear submarine "Squid" (Delta III) with sixteen launchers on board in August

1977 Serial production launched at the Krasnoyarsk Machine-Building Plant.

A two-stage underwater-launched intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel. It has an astroinertial control system. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Main engines were developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev and V. Bogomolov. The maximum firing range is 8000 km (according to some sources - 6500 km). Launch weight - 35.3 tons. Rocket length - 14.1 m. Maximum body diameter - 1.8 m. Payload weight - 1.65 tons. Nuclear warhead power of a monoblock warhead - 0.55 Mt.

Based on the R-29R SLBM, the attraction of the Volna space launch vehicle.

The complex is in service.

D-9RL. R-29RL (RSM-50) [SS-N-18. STINGRA

The D-9RL missile system with an underwater-launched intercontinental ballistic missile for submarines. The first domestic SLBM equipped with MIRVs for individual targeting. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began in 1973. Flight design tests took place from 1976 to 1978. The nuclear submarine of project 667BDR "Kalmar" (Delta III) with sixteen launchers on board was accepted into service in 1979. Serial production was launched at the Krasnoyarsk Machine-Building Plant.

A two-stage underwater-launched intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel. Has astroinertial control system. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Main engines were developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev and V. Bogomolov. The propulsion system of the combat breeding stage is a four-chamber rocket engine.

The maximum firing range is 6500 km. Launch weight - 35.3 tons. Rocket length - 14.1 m. Maximum body diameter - 1.8 m. Payload weight - 1.65 tons. The multiple warhead is equipped with three warheads for individual targeting of 0.2 nuclear weapons Mt. The complex is in service.

D-9K. R-29K (RSM-50) [SS-N-18. STINGRAY]

The D-9K missile system with an underwater-launched intercontinental ballistic missile for submarines. The missile is equipped with a MIRV for individual targeting. Development at the Miass design bureau of mechanical engineering under the leadership of Viktor Makeev began in 1973. Flight design tests took place from 1976 to 1978. The nuclear submarine of project 667BDR "Kalmar" (Delta III) with sixteen launchers on board was accepted into service in 1982. One A nuclear submarine is a way to fire at 112 targets in one salvo.

A two-stage underwater-launched intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel. Has an astroinertial control system. Budget management system in the Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. Main engines were developed at the Chemical Engineering Design Bureau under the leadership of Alexey Isaev and V. Bogomolov. The propulsion system of the combat breeding stage is a four-chamber rocket engine.

The maximum firing range is 6400 km. Launch weight - 35.3 tons. Rocket length - 14.1 m. Maximum body diameter - 1.8 m. Payload weight - 1.65 tons. The multiple warhead is equipped with seven warheads for individual targeting of 0.1 nuclear weapons Mt.

R-39

D-19. R-39 (RSM-52). 3M65 [SS-N-20. STURGEON]

The D-19 missile system with a surface-launched intercontinental ballistic missile for submarines. The first domestic solid-fuel intercontinental SLBM. Equipped with MIRV for individual targeting. Development at the Miass Mechanical Engineering Design Bureau under the leadership of Viktor Makeev began in 1971. Development of the Typhoon system began in 1973.

In 1973, the Moscow Transport Engineering Design Bureau, under the leadership of Vsevolod Solovyov, began the development of ground equipment to support flight testing and rockets. Considering that the overall weight characteristics of the rocket were very different from all existing loaders, it was decided to develop a transport option for the rocket from the manufacturer to the pier with the exception of crane reloading operations. The following were developed: a throw-test complex (CTS), a ground-based launch complex (GLS), a ground-based equipment complex (GES), a complex of missile loading facilities (KSPR), projects for rocket-technical bases of the fleet (RTBF). In two years, cancer Operation KBI provided tests with 20 launches. The first stage of the R-39 SLBM is unified with the first stage of the RT-23 ICBM designed by Mikhail Yangel. The development of the engine for the first stage of the R-39 naval missile (launch weight - 52.8 tons, length - 9.5 m, body diameter - 2.4 m) was entrusted to the Yuzhnoye Design Bureau in September 1973. Fire tests of the 3D65 engine in The missile composition began on September 9, 1980. Flight testing of the missile from a submarine began in December 1981. Serial production of the first stages of the RT-23 and R-39 missiles was launched at the Pavlograd Mechanical Plant.

The complex was put into service with the Project 941 Akula (Typhoon) nuclear submarine with twenty launchers on board in May 1983. One nuclear submarine can fire 200 targets in one salvo. The launch of missiles is ensured by a powder pressure accumulator from “dry” silos, which makes it possible to fire from nuclear submarines located underwater and on the surface.

Three-stage intercontinental ballistic missile with solid propellant rocket engine. The engines of the second and third stages have retractable nozzles. Has astroinertial control system. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The launcher elements are placed on the rocket. The rocket flight control in the first stage operation area is carried out by blowing gases from the main engine chamber into the supercritical part of the nozzle. The maximum firing range is 8300 km. The mass of the rocket with launcher elements is 90 tons. The launch weight of the rocket is 84 tons. The length of the rocket is 16 m. The maximum diameter of the body is 2.4 m. The payload weight is 2.55 tons. The multiple

warhead is equipped with ten warheads for individual targeting of the target nuclear weapon 0.1 Mt. The missile warehouse is located in Nenoksa.

From March 1996 to December 1997, 40 R-39 missiles were eliminated using the submarine launch method. Based on the R-39 SLBM, the Rif-M space launch vehicle.

The complex is in service.

D-19. R-39 MODERNIZED (RSM-52). [SS-N-20. STURGEON]

The D-19 missile system with a surface-launched intercontinental ballistic missile for submarines. An improved version of the R-39 SLBM. Equipped with MIRV for individual targeting. Development at the Miass mechanical engineering design bureau under the leadership of Igor Velichko began in 1985. In 1992, the throw testing stage was completed. Until 1997, 12 missiles were launched using ground-based equipment.

Rocket testing has been stopped.

R-29RM

D-9RM. R-29RM (RSM-54). 3M37 [SS-N-23. SKIFF]

The D-9RM missile system with an intercontinental ballistic missile for submarines. The missile is equipped with a MIRV for individual target guidance. Can be used for installing small objects. Development at the Miass Mechanical Engineering Design Bureau under the leadership of Viktor Makeev began in 1979. Development continued under the leadership of Igor Velichko. The throw test complex (CTS), the ground launch complex (GSC) and the ground equipment complex (GES) were developed at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov. In 1981-1982. KBI provided throw tests of the rocket with 9 launches. From 1983 to 1984, the NSC provided preparation and launches of 16 missiles. At the stage of joint testing with the submarine, 18 missiles were launched. The complex is in two versions of the nuclear submarine Project 667BDRM "Dolphin" (Delta IV) with six launchers on board in 1986. Missiles of the first version of the MIRV with ten warheads. Missiles of the second version of the MIRV with four warheads. Serial production has been launched at the Krasnoyarsk Machine-Building Plant.

A three-stage intercontinental ballistic missile with a liquid-propellant rocket engine using stored high-boiling fuel. The control system uses astrocorrection and correction of the flight path based on navigation satellites. Budget management system in Sverdlovsk OKB-626 (NPO Automation) under the leadership of chief designer Nikolai Semikhatov. The first stage remote control has 4 steering chambers. The third stage and the combat stage of the rocket have common fuel tanks and a single

unit with the propulsion system. The missile has an increased size of the warhead disengagement zone. The propulsion engines were developed at the Chemical Engineering Design Bureau under the leadership of V. Bogomolov. The maximum firing range is 8300 km. Launch weight - 40.3 tons. Rocket length - 14.8 m. Maximum body diameter - 1.9 m. Payload weight - 2.8 tons. The multiple warhead is equipped with ten or four warheads for individual targeting of nuclear weapons 0, 1 Mt. A modification equipped with four warheads has been adopted for service. Underwater launch of missiles is carried out with a depth of 55 m at a sea state of 6-7 points and a nuclear submarine speed of up to 6 knots. All ammunition is fired in one salvo.

Since 1988, the rocket has been modernized. During the modernization, the missile was equipped with improved warheads, the ability to launch along a table-top trajectory was provided, and resistance to the damaging factors of a nuclear explosion was increased.

Based on the R-29RM SLBM, space launch vehicles Shtil-2, Shtil-3 and their modifications were developed. The complex is in service.

R-29RM

R-39

R-31

"BARK" (RSM-56) [SS-NX-28]

The development of the missile system began at the State Missile Center "Design Bureau named after Academician V.P. Makeev" under the leadership of General Designer Igor Velichko in 1986. The three-stage intercontinental solid-fuel SLBM is a further development of the R-39 missile. “in Severodvinsk since November 1996, and also re-equipped the Typhoon submarines.” Flight tests began in 1996. On November 19, 1997, the third test launch of the rocket was carried out at the Central Marine Missile Test Site in Nenoksa, which ended unsuccessfully.

D-6

Project of the D-6 missile system with a solid-fuel ballistic missile for submarines. Development at TsKB-7 of the Arsenal plant under the leadership of Pyotr Tyurin began in 1958. It was supposed to create a rocket using ballistic gunpowder. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vladimir Petrov. In April 1961, the development of the missile system was stopped due to the start of development of the promi RT-15 rocket using solid mixed fuel.

D 7. RT-15M. 4K22

In parallel with the RT-15 medium-range land-based ballistic missile, TsKB-7 of the Arsenal plant, under the leadership of chief designer Pyotr Tyurin, in accordance with the government decree of April 4, 1961, was developing a solid-fuel ballistic missile using mixed underwater launch fuel for submarines RT-15M of the D-7 complex. Development was carried out on the basis of the second and third stages of the RT-2 ICBM. It was supposed to equip the Project 667A nuclear submarine with these missiles, the development of which was carried out at TsKB-18. To test the complex, an experimental Project 613 submarine was converted. The designed firing range is 2400 km. The length of the rocket is 10.5 m. The maximum diameter of the body is 1.5 m. The launch weight is 50 tons. Tests of the land RT-15 have been delayed, the project of the sea RT-15Marel. In 1968, it was decided to terminate the RT-15M project and start a new R-31 project. The RT-15M missile was not accepted for service.

D-11. R-31 (RSM-45). 3M17 [SS-N-17]

The D-11 missile system with an underwater launch ballistic missile for submarines. The first domestic solid-fuel SLBM. Development at TsKB-7 of the Arsenal plant under the leadership of Pyotr Tyurin began in 1971 (according to other sources, in 1970). Flight design tests took place from 1973 to 1979. The first underwater launch took place on December 26, 1976. The complex was used in the trial operation of the Project 667AM Navaga-M (Yankee II) nuclear submarine with twelve launchers on board in 1980. This is - modernized Project 667A nuclear submarine. In 1969-1971 A project for a nuclear submarine armed with sixteen R-31 missiles was being developed, but this project was not developed.

Two-stage ballistic missile with solid propellant rocket engine using mixed fuel. For the first time, a rocket launch was provided by a powder pressure accumulator from “dry” mines without first filling them with water. The launch was carried out using a powder pressure accumulator; the propulsion engine was started after the rocket left the water. This allows you to reduce the preparation time for launch and reduce the noise level of the submarine during preparation for launch. The ground equipment complex was developed at the Moscow Transport Engineering Design Bureau under the leadership of Vsevolod Solovyov.

The maximum firing range is 3900 km. Launch weight - 26.9 tons. Rocket length - 11.06 m. Maximum body diameter - 1.54 m. Payload weight - 0.45 tons. Nuclear warhead power of a monoblock warhead - 0.5 Mt. Firing could be carried out from a depth of up to 50 m. All missiles exited the launcher within one minute. The D-19 complex with the R-31 missile was not widespread. The fleet used the only nuclear submarine K-140 as a carrier.

Withdrew from service in 1990.

D-3. R-15

Project of the D-3 complex with an underwater launch ballistic missile for submarines. By government decree of August 17, 1956, the development of the rocket project was entrusted to the Yuzhnoye Design Bureau (chief designer - Mikhail Yangel). The preliminary design of the missile was developed in September 1957. The missile was supposed to have a firing range of 1000 km. Three launchers were placed on Project 639 submarines, the development of which began at the Malachite MBM in August 1956.

On December 3, 1958, development of the complex project was stopped.

SLBM of the Moscow Institute of Thermal Engineering

The development of a missile system for the Navy began at the State Enterprise "Moscow Institute of Thermal Engineering" under the leadership of General Designer Yuri Solomonov.

Three-stage intercontinental SLBM with solid mixed fuel engines and MIRV. It is assumed that the missiles will be equipped with the lead nuclear submarine "Yuri Dolgoruky" of Project 955 "Borey" (12 SLBMs on board), the construction of which has been carried out by the Sevmashpredpriyatie PA in Severodvinsk since November 1996.

.

- About airplanes
- About tanks
- Miscellaneous
- Airplane
- Aircraft
- Tank
- Tanks